# 2015 Oregon State University Combined Research and Extension Annual Report of Accomplishments and Results

**Status: Accepted**

**Date Accepted: 05/16/2016**

## I. Report Overview

### 1. Executive Summary

### 1. Executive Summary

In this annual report, the Oregon Agricultural Experiment Station (OAES) will summarize outputs and outcomes from its six Planned Programs.

**Collaboration**

The Oregon Agricultural Experiment Station (OAES) during the 2013 year continues its tradition of collaboration across disciplinary and organizational lines. This year, collaborative work has been expanded more broadly as the Station has begun implementing six new research projects to address NIFA program areas.

**Funding**

One of the Experiment Station's state performance metrics is external funds leveraged per dollar of state funding. In 2013-2014, $24.5 million in state appropriations were leveraged by faculty to generate $76.9 million in external fund expenditures, yielding a metric of over 3:1.

**NIFA Program Areas**

Research programs address the six thematic areas defined by the National Institute for Food and Agriculture. Program foci cover Sustainable Energy (Water and Watersheds), Climate Change, Global Food Security, Food Safety, and Obesity. The following are highlights from these Planned Programs.

**Climate Change**

An interdisciplinary team of scientists from the College of Agricultural Sciences at OSU is focusing on the adaptation and mitigation impacts of climate change as they relate to key sectors within Oregon, mindful of the regional and global connections. Team members are enhancing existing agricultural and biological models, life cycle models and economic/policy models, and exploring the opportunities and the methods to couple them (formally and informally) to better understand interactions among climate, crop and land use changes, ecological and environmental changes, and policy and economic factors.

**Global Food Security and Hunger**

Global food security represents access to food at many levels. The health of the animal food sources, as well as plant sources, is important to maintainand expand the nutritionofpopulations.However, disease is still common in food sources. Many pathogens evolved to survive in the prevailing conditions existing during the course of food production and foodconservation may be deficient even in the developed world. Further, if the source of the food is diseased, for example, Johne's disease in cattle or Vibrio tubiashii in seafood or Clostridium perfringens infections inseveral meat animals (pork, poultry, etc) , the security of food will be compromised. We propose objectives which address aspects associated with food security during food animal production, that is, developing diagnostic tests and vaccines and creating a

betterunderstanding ofthe mechanismsof pathogenesis of many virulent bacteria and viruses.

**Food Safety**

The implementation of the Food Safety and Modernization Act (FSMA) will have a major impact on agriculture, especially small farms throughout the U.S. A critical need exists for development of a cost effective and simple-to-implement Food Traceability System(FTS) for small producers and processors. OSU researchers will model several small scale food production systems: berries, tree nuts, seafood and meats in order to identify and report both common andunique barriers to FTS implementation. The team will evaluate current technology in the context of how it's able to be implemented and recommend solutions for FTS implementation for small-scale systems.

**Childhood Obesity**

The project team will apply a social-ecological fframework to study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as increase acceptability. The study will also determine if the greater exposure and familiarity with whole grains, vegetables and fruits increases the selection and incorporation of these foods into typical dietary patterns at home and in school lunches as well as among seniors in residential retirement communities.

**Sustainable Energy**

While methods to ensure sustainability of the energy resources have been sufficiently well developed, other natural resources such as water and nutrients are not often considered in detail in these frameworks.With the emerging nexus of bioenergy production and water there is a need to develop and validate assessment frameworks that can be used to evaluate the sustainability of energy, water and other natural resources in a unified theoretical framework. This is especially important for water limited U.S. Pacific Northwest (PNW) region in the context of global climate change scenarios.
Declining oil prices and policy uncertainty surrounding biofuels, bioenergy, and biopower have limited

grant opportunities and reduced financing for commercial application of these technologies. As a result, research effort for developing new feedstocks and conversion technologies has been reduced. This is unfortunate in the PNW, where new sustainable forestry practices have the potential to produce a substantial supply of biomass for creation of a new bioeconomy.

**Food, Energy, Water Nexus**

**Total Actual Amount of professional FTEs/SYs for this State**

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| Plan | 188.0 | 0.0 | 215.0 | 0.0 |
| Actual | 181.0 | 0.0 | 215.0 | 0.0 |

## II. Merit Review Process

### 1. The Merit Review Process that was Employed for this year

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

### 2. Brief Explanation

Merit reviews of collaborative proposals are reviewed by the Director, Associate Directors and the Assistant Director prior to project consideration for internal review. Internal reviews were conducted by staff and faculty prior to each proposal being submitted to expert peer review. Peer reviewer comments were incorporated into the final proposals before submission to NIFA for subsequent review.

## III. Stakeholder Input

### 1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public

**Brief explanation.**

The Director, as well as Associate Directors, Assistant Director and the External Relations Director, traveled throughout the state to interact at formal and informal stakeholder events. Events included field days, special commodity events, County and State fairs, faculty organized conferences and workshops. They also attended events organized by various industry, public and nonprofit entities to interact with stakeholders. Faculty also attended all events.

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

**1. Method to identify individuals and groups**

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys
- Other (blogs, fairs, websites, social media sites, webinars, )

**Brief explanation.**

Extension, Station, and departmental faculty, as well as unit leadership provide information on critical stakeholders and groups. The deans and the External Relations Director also identify important clientele through their many contacts. The Director's advisory group is composed of industry and community leaders. They meet regularly to update the Station administrators about critical issues and developments around the state or in their industry. Modern internet tracking technology allows us to identify people that are engaging with us through our websites, webinars, and social media. This has allowed us to reach out to individuals and organizations that may have been previously unknown to CAS.

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

**1. Methods for collecting Stakeholder Input**

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey of the general public
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals

- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public
- Other (webinars, social media, web content and comment)

**Brief explanation.**

Specific events were scheduled to gather input as well as continually recieving unsolicited input through a variety of public venues open to stakeholders and non-stakeholders alike. The University and College just completed a $1.1 billion dollar capital campaign that generated considerable input from a variety of non-traditional sources. The Strategic Intent process was used to garner input from other University Stakeholders from outside the College to aid with creation of joint mission areas and collaboration that encompasses all entities involved in natural resource management.
As mentioned elsewhere, technological advancements such as web hosting, social media, and provision of information through webinars or other means have allowed us to reach new stakeholders as well as allowing these new stakeholders to reach us.

**3. A statement of how the input will be considered**

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

**Brief explanation.**

The Station and Extension use this information when establishing budget allocations, proposing capital projects, allocation of research dollars and matching funds, and for priority staffing. The College Strategic Intent document is updated annually as stakeholder input shapes research and extension focus and priorities. Stakeholder input is also important during the faculty and administrator review process to ensure that College personnel are responding to stakeholder needs within budget and staffing limitations.

**Brief Explanation of what you learned from your Stakeholders**

Public awareness of the impacts of agriculture on health, nutrition, environment and security is demanding broadening of existing research focus while acknowledging the need for additional research and dissemination of that research. Unfortunately, a lack of adequate funding for these programs is constraining the potential positive impacts of new or emerging knowledge. This is particularly true for genomic and bioinformatic applications that can address linkages between human health and diet.

Stakeholders are demanding more focus on water and water allocation as drought conditions expand across the West. Additionally, food safety appears to be emerging as a contentious issue as food borne pathogen outbreaks occur more frequently within the food supply and the presence of genetically modified materials become more common in the food supply chain. Addressing the amount of food waste produced annually in the U.S. and our inability to convert this waste into bioproducts that can replace fossil fuels continues to be confounded by low fossil fuel prices and a

lack of public awareness and interest in addressing this issue.

There is increasing demand for more "urban based" agricultural research particularly for pest management, small farms, farmer's markets, master gardeners, and nursery crops. While we have responded to this demand, we continue to struggle to find ways to support this effort without the expansion of service districts and other revenue generating methods that are foreign to urban populations. Rural areas continue to struggle with declining economies, emigration to areas with better paying jobs, and dramatic changes in landscapes and land ownership as more effluent urban dwellers seek to live at least part time, in rural areas. New laws that raise the minimum wage for farm labor will have a substantial impact on the profit margins of labor intensive agricultural operations such as small fruits production and organic vegetable production.

Globalization increases the amount of Oregon agricultural products that enter the global market but often creates competition that can suppress prices. Similarly, transportation bottlenecks such as ocean port labor disputes and reduced rail capacity resulting from oil transport continue to hinder market development and expansion. Although international trade agreements allow agricultural producers access to new markets, heavy industry generally views these agreements as damaging to those markets and these agreements face an uphill battle for adoption in the near future.

## IV. Expenditure Summary

| 1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS) | | | |
|---|---|---|---|
| Extension | | Research | |
| Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| 3887542 | 0 | 3800407 | 0 |

| 2. Totaled Actual dollars from Planned Programs Inputs | | | | |
|---|---|---|---|---|
| | Extension | | Research | |
| | Smith-Lever 3b & 3c | 1890 Extension | Hatch | Evans-Allen |
| Actual Formula | 1662159 | 0 | 3747231 | 0 |
| Actual Matching | 1662159 | 0 | 33211582 | 0 |
| Actual All Other | 3064148 | 0 | 26402805 | 0 |
| Total Actual Expended | 6388466 | 0 | 63361618 | 0 |

| 3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous | | | | |
|---|---|---|---|---|
| Carryover | 0 | 0 | 720343 | 0 |

# V. Planned Program Table of Content

## V(A). Planned Program (Summary)

**Program # 1**

**1. Name of the Planned Program**

Sustainable Energy

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 125 | Agroforestry | 7% | | 0% | |
| 131 | Alternative Uses of Land | 0% | | 10% | |
| 132 | Weather and Climate | 0% | | 10% | |
| 133 | Pollution Prevention and Mitigation | 0% | | 30% | |
| 402 | Engineering Systems and Equipment | 20% | | 20% | |
| 403 | Waste Disposal, Recycling, and Reuse | 7% | | 20% | |
| 511 | New and Improved Non-Food Products and Processes | 21% | | 10% | |
| 601 | Economics of Agricultural Production and Farm Management | 8% | | 0% | |
| 608 | Community Resource Planning and Development | 7% | | 0% | |
| 609 | Economic Theory and Methods | 17% | | 0% | |
| 903 | Communication, Education, and Information Delivery | 13% | | 0% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 6.0 | 0.0 | 3.0 | 0.0 |
| **Actual Paid** | 6.0 | 0.0 | 25.0 | 0.0 |
| **Actual Volunteer** | 44.0 | 0.0 | 0.0 | 0.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 50931 | 0 | 393390 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 50931 | 0 | 3489027 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 151870 | 0 | 988503 | 0 |

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

### 1. Brief description of the Activity

In summary:
- Conduct basic and applied research
- Develop models and simulation tools including LCA and LES.
- Develop new culture strains and metabolic engineering tools
- Develop energy saving techniques and recycling of green waste
- Develop products, resources
- Conduct surveys and assessments
- Conduct data analyses
- Conduct workshops
- Lead short course and training seminars
- Provide training
- Partner and engage with community and environmental organizations
- Contribute to trade and peer reviewed journal publications

### 2. Brief description of the target audience

The target audiences are:

- public sector
- private sector
- economists
- policy makers
- agricultural biotechnology firms
- farmers and agricultural managers
- livestock growers and managers
- energy (including bioenergy/biofuel, hydrogen and fuel cells) industry,
- forest owners and managers
- research community at large
- environmental organizations
- community members

### 3. How was eXtension used?

eXtension was not used in this program

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

### 1. Standard output measures

| 2015 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 32043 | 86884 | 13732 | 36384 |

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

**Patent Applications Submitted**

Year: 2015

Actual: 0

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2015 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 6 | 35 | 41 |

## V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and bioproducts, including co-products (number of new technologies developed, feedstocks (crops or organisms) investigated, residues or invasive species addressed) |
| 2 | Improved agricultural or engineering applications to advance production systems for bioenergy, such as, a) new technologies, such as improved water use and quality, optimized photobiological processes to yield higher energy efficiencies, use of waste biomass (such as animal wastes and the organic component of urban wastewater) as feedstock to yield bioenergy and reduce waste and pollution sources, b) improved feedstock logistics c) resource inputs, outputs and quality |
| 3 | Models developed to look at biofuel and bioenergy productivity, technological processes, sustainability, and supply chain (numbers of decision tools, economic and life cycle analyses, productivity analyses) |
| 4 | Enhanced or improved bioeconomy (analyses of the number of new jobs, increased revenues, gallons of biofuels produced or consumed, gallons of fossil fuel displaced), numbers of farms involved in feedstock production) |
| 5 | Increased knowledge regarding the use of agricultural crops for energy production (percent increase in knowledge of attendees to workshops, field days and demonstrations) |
| 6 | Improved sustainability of alternative energy supply chain, including evaluations of land use changes, biodiversity, acreages and tonnage of feedstocks produced and used, distributed conversion and processing, |
| 7 | Increased knowledge regarding the use of forest biomass as an energy source (Percentage increase in knowledge of attendees to workshops, field days, and demonstrations) |
| 8 | Increased knowledge of wave energy, particularly by coastal stakeholders (Percent increase in knowledge of attendees to workshops, field days, and demonstrations) |
| 9 | A framework for the attrbutional LCA based on the ISO standards will be extended to include water use metrics. These metrics will be defined based on source (confined and unconfined aquifers, surface runoff and precipitation), quality, quantity (consumptive and degradative use) and water stress index (volume of withdrawals in the watershed compared to the annual recharge) by adapting several published methods. Metrics for nitrogen and phosphorous utilization will also be developed along similar lines. |
| 10 | Biodiesel production from canola in the Pacific Northwest region will be used as a test case for the methodology developed for water use as an LCA component. Previously developed process models incorporating feedstock handling, pretreatment, transesterification, and coproduct utilization, waste water handling will be further refined to incorporate process efficiency variations. Cellulosic ethanol production from agricultural residues such as wheat straw and grass straw will be used to test the methodology. Algal biofuels production will be modeled based on algae biomass production using municipal waste water as a nutrient source willbe performed. Processing of algae would be based on recently suggested scheme that consists of harvesting algae biomass using flocculation and processing the resulting slurry into biocrude using hydrothermal liquefaction process and the upgraded into green diesel and jet fuel. |
| 11 | Examine idealized cases with LES utilizing simulation modeling compared with theoretical and field work. Construct a model to represent the local topography of an individual farm to investigate the coupled effects of topography, spatial variability in water application and wind turbines |

**Outcome #1**

**1. Outcome Measures**

Improved knowledge about composition and conversion of feedstocks for biofuels, bioenergy, and bioproducts, including co-products (number of new technologies developed, feedstocks (crops or organisms) investigated, residues or invasive species addressed)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Lignocellulosic biomass represents a significant potential source of renewable energy that can contribute to national transportation needs without competing for land needed for food crops. This abundant material consists of lignan, cellulose and hemicellulose. The latter two constituents are polymeric forms of sugar that release fermentable sugar following enzymatic or chemical degradation. The sugar that is released can then be fermented by yeast (and other microorganisms) to produce fuel alcohol. Because native lignocellulosic biomass is highly refractory to degradation, pre-treatments are needed to make the cellulose component more accessible. Such treatments also generate high levels of toxic compounds such as acetic acid that inhibit the subsequent fermentation, and thus impede practical development of this energy source. We propose to determine how acetic acid-mediated inhibition of yeast can be overcome, and to use this information to construct yeast strains with enhanced acetic acid tolerance.

**What has been done**
This project made significant contributions to the overall goal of finding ways to reduce the toxicity of acetic acid towards the yeast Saccharomyces cerevisae. Most important, these findings provide independent and promising avenues for follow up work that could result in increasing the acetic acid tolerance of industrial strains of yeast used to make cellulosic ethanol.

**Results**
Our major findings from the screen and analysis of acetic acid-resistant deletion mutants are 1) the condition of nutritional auxotrophy alone increased sensitivity to acetic acid because acetic acid inhibits nutrient uptake, and 2) mutations that interfere with nutritional starvation-mediated

growth inhibition led to greater acetic acid resistance in an auxotrophic genetic background. The practical outcome from these findings is that it is best to screen for acetic acid resistant mutants in a prototrophic background or one in which the auxotrophy can be complemented. None of the mutations found to be beneficial in an auxotrophic background were found to confer resistance in a prototrophic background.

Our major findings from the screen of the overexpression library are that acetic acid resistance can be increased by over expressing the PEP3 gene which in turn led to increased vacuolar ATPase activity. Independently, acetic acid tolerance was found to be increased by overexpressing the STM1 gene which has been reported to protect ribosomes from nutritional stress-related degradation.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 125 | Agroforestry |
| 131 | Alternative Uses of Land |
| 133 | Pollution Prevention and Mitigation |
| 402 | Engineering Systems and Equipment |
| 403 | Waste Disposal, Recycling, and Reuse |
| 511 | New and Improved Non-Food Products and Processes |

**Outcome #2**

**1. Outcome Measures**

Improved agricultural or engineering applications to advance production systems for bioenergy, such as, a) new technologies, such as improved water use and quality, optimized photobiological processes to yield higher energy efficiencies, use of waste biomass (such as animal wastes and the organic component of urban wastewater) as feedstock to yield bioenergy and reduce waste and pollution sources, b) improved feedstock logistics c) resource inputs, outputs and quality

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Soil is a critical resource for food and bioenergy production and the physical manifestation of the water-energy nexus. Soil management requires mechanistic understanding of interactions between soil components. Research during 2015 was directed at understanding the role of the soil organic matter component as an inevitable part of the soil system by testing a variety of biochars to improve water use and biomass production.

**What has been done**
Organic Matter decomposition processes were investigated and conceptual models for these processes developed. The structural properties of a promising soil amendment (biochar) were investigated and described.

**Results**
Suggestions for the replacement of several paradigms were published in high impact journals (PNAS, Nature Climate Change, Nature).

A 140 page Review of Mineral-organic interactions was compiled and published.

The structural properties of Biochars were reviewed and investigated. Results were published in refereed journals and as chapters of the new Routledge Biochar Book

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 133 | Pollution Prevention and Mitigation |
| 402 | Engineering Systems and Equipment |
| 403 | Waste Disposal, Recycling, and Reuse |
| 511 | New and Improved Non-Food Products and Processes |
| 601 | Economics of Agricultural Production and Farm Management |
| 608 | Community Resource Planning and Development |
| 903 | Communication, Education, and Information Delivery |

**Outcome #3**

**1. Outcome Measures**

Models developed to look at biofuel and bioenergy productivity, technological processes, sustainability, and supply chain (numbers of decision tools, economic and life cycle analyses, productivity analyses)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
As part of a multi-institution team, designed and conducted a series of greenhouse and field studies on domestication requirements of Alyssum species to use as phytomining crops to produce nickel and biomass energy.

**What has been done**
The phytomining research required over $1 million in research funding, and about $250,000 of that was spent directly in Josephine and Jackson Counties. Over 200 acres of land are currently in phytomining seed or biomass production in Josephine Co. As a result of the research, improved cultivars were selected and management practices defined, allowing Viridian to sign agreements with Inco Inc. (world? largest nickel producer) allowing them to grow phytomining crops on over 500,000 acres of Inco-controlled land on 6 continents. Because of the poor agricultural quality of land typically used in phytomining, the typical gross return to the landowner increases from $150/ac/yr from marginal pasture crops to $600/ac/yr (using conservative yield values).

**Results**
Results were presented through four journal articles, four invited talks, five peer reviewed conference proceedings, and nine scientific abstracts. Two patent applications have been prepared and one has been submitted.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 402 | Engineering Systems and Equipment |
| 511 | New and Improved Non-Food Products and Processes |
| 601 | Economics of Agricultural Production and Farm Management |
| 608 | Community Resource Planning and Development |
| 903 | Communication, Education, and Information Delivery |

## Outcome #4

### 1. Outcome Measures

Enhanced or improved bioeconomy (analyses of the number of new jobs, increased revenues, gallons of biofuels produced or consumed, gallons of fossil fuel displaced), numbers of farms involved in feedstock production)

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
In recent years, food and energy prices have experienced dramatic fluctuations in many countries as their economies move from boom to bust. Right before the 2007 global financial crisis, the price of crude oil hit record highs of nearly $150 a barrel, and the prices of food and major agricultural commodities also rose sharply in many countries. For example, in the United States the real price of corn almost doubled from 2005 to 2007, and food prices experienced the largest increase in 20 years. The dramatic price increases were claimed to be a direct, self-inflicted result of America?s rush to biofuels and an adverse consequence of U.S. biofuel policies (The Economist 2007). A recent study by Almirall et al. (2010) found that increased corn ethanol production explained approximately 30 % of the corn price increase from 2006 to 2007. Roberts and Schlenker (2010) evaluated the impact of ethanol subsidies and mandates on world food commodity prices and found that the current U.S. ethanol mandates increased world food commodity prices by as much as 30 %. Other studies (e.g., McPhail and Babcock 2008), however, found the ethanol policy had much smaller impacts1 (see Abbott et al. 2008; Pfuderer et al. 2010 for a review). The economic literature has yet to agree on the magnitude of the price effects (Roberts and Schlenker 2010; Chen et al. 2011)."

**What has been done**
we examine the effects of biofuel mandates and subsidies on prices of crops, energy, and on consumer welfare in a general equilibrium framework. Our framework has three desirable features. First, instead of treating biofuel mandates and subsidies separately, we focus on their interactions. We show that the price and welfare effects of bio- fuel subsidies, to a large effect, depend on the level of biofuel mandates. Second, we model both the direct and indirect effects of biofuel subsidies and mandates on food and energy markets. Economists have long recognized that taxes or subsidies can generate distortional costs by driving a wedge between marginal

benefits and marginal costs (Harberger 1964)."

**Results**

Our results suggest that biofuel mandates are a primary cause of some of the major concerns associated with crop-based biofuel production, including higher prices of crops, food and fuels and lower consumer welfare. The effect of biofuel subsidies on prices of crops, food, and energy depends on the level of biofuel mandate. When the mandate is weak or not binding, a biofuel subsidy becomes a transfer, which tends to reduce the prices of food and fuel because of the negative income effect. However, with a strong mandate, a biofuel subsidymay increase the prices of food and fuel because it encourages producers to use more of the expensive input. For a given level of biofuel mandate, a biofuel subsidy is more likely to increase the prices of crops when (1) the output elasticity of fuel input in the production of mixed fuel is larger, (2) a larger amount of crop is needed to produce a unit of biofuel, and (3) the crude oil price is low.Abiofuel subsidy ismore likely to increase the price of crop than the prices of food and fuels because it is the higher crop price that causes the food and fuel prices to increase. If the crop accounts for a large share of production cost of food and fuel and the supply of crop is inelastic, a biofuel subsidymay lead to higher prices of food and fuel aswell.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 402 | Engineering Systems and Equipment |
| 601 | Economics of Agricultural Production and Farm Management |
| 608 | Community Resource Planning and Development |
| 609 | Economic Theory and Methods |

**Outcome #5**

**1. Outcome Measures**

Increased knowledge regarding the use of agricultural crops for energy production (percent increase in knowledge of attendees to workshops, field days and demonstrations)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Nitrogen (N) is the most important fertilizer used in grass seed production. Applied N increases seed yield in grass seed crops by increasing the number of seeds produced and by increasing seed weight. Nitrogen application increases the profitability of grass seed production enterprises. Grass straw has drawn increasing attention as a potential feedstock for production of alternative jet fuel through a new gasification plant and renewable fuel biorefinery under construction in SW Oregon. However, the cost of this input has been steadily increasing over time, so enhancing fertilizer N efficiency is important.

**What has been done**

Six trials were conducted in first-year perennial ryegrass seed fields at three on-farm sites in 2013-2015 in Marion, Yamhill, and Washington counties.
Fertilizer treatments included the following:
Two N rates applied as 40-0-0-6, representing the range of recommended rates for perennial ryegrass seed crops in Oregon (120?160 lb N/acre), with and without Agrotain Ultra®
A split application of 160 lb N/acre, with 50% applied as 40-0-0-6 with Agrotain Ultra® and 50% applied as liquid UAN.
At two sites, an N application of 120 lb N/a, applied as 40-0-0-6 with N-Veil®, another NBPT-containing urease inhibitor.

Above-ground biomass samples were taken at peak anthesis, and dry weight of the standing crop was determined by drying and subsequent weighing of the harvested material. Total C and N in plant tissue samples were determined by using a LECO CNS analyzer. Seed was harvested with grower combines, and seed yield was determined with a weigh wagon. Seed weight was determined by counting two 1,000-seed samples with an electronic seed counter and weighing these samples on a laboratory balance.

**Results**

N fertilizer rates and NBPT-containing urease inhibitors influenced seed yields differently among the six sites. In 2014, a 15 percent seed yield increase resulted at two of the three sites when NBPT was used with 135 kg N/ha and seed yield increased by 10 percent at one site when NBPT was used with 179 kg N/ha. There were no differences in seed weight or total tissue N among N rate or urease inhibitor treatments. In 2015, there were no differences in seed yield, seed weight, or total tissue N among N rate or urease inhibitor treatments at any of the sites. This is the first report on effects of NBPT-containing urease inhibitors on grass seed production in western Oregon. These results indicate that NBPT urease inhibitor products have potential for improving N fertilizer use efficiency and yield in grass seed crops when rainfall is absent immediately following N application. However, positive effects were inconsistent and use of urease inhibitor coatings should be used cautiously to minimize cost.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 511 | New and Improved Non-Food Products and Processes |
| 601 | Economics of Agricultural Production and Farm Management |
| 903 | Communication, Education, and Information Delivery |

## Outcome #6

### 1. Outcome Measures

Improved sustainability of alternative energy supply chain, including evaluations of land use changes, biodiversity, acreages and tonnage of feedstocks produced and used, distributed conversion and processing,

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Providing food, timber, energy, housing, and other goods and services, while maintaining ecosystem functions and biodiversity that underpin their sustainable supply, is one of the great challenges of our time. Understanding the drivers of land-use change and how policies can alter land-use change will be critical to meeting this challenge.

**What has been done**
Here we project land-use change in the contiguous United States to 2051 under two plausible baseline trajectories of economic conditions to illustrate how differences in underlying market forces can have large impacts on land-use with cascading effects on ecosystem services and wildlife habitat. We project a large increase in croplands (28.2 million ha) under a scenario with high crop demand mirroring conditions starting in 2007, compared with a loss of cropland (11.2 million ha) mirroring conditions in the 1990s. Projected land-use changes result in increases in carbon storage, timber production, food production from increased yields, and >10% decreases in habitat for 25% of modeled species. We also analyze policy alternatives designed to encourage forest cover and natural landscapes and reduce urban expansion.

**Results**
Despite these modeling caveats, our results provide an em- pirically based estimate of the ability of relatively strong land-use based policies to deliver ecosystem services. Perhaps the most important lesson that emerges from our analyses is that there are powerful underlying trends that will drive land-use change, as illustrated by the two baseline scenarios that we examined. Land-use patterns can be affected by policy interventions, but such interventions will need to be aggressive to significantly alter underlying land-use change trends.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 125 | Agroforestry |
| 131 | Alternative Uses of Land |
| 133 | Pollution Prevention and Mitigation |
| 402 | Engineering Systems and Equipment |
| 601 | Economics of Agricultural Production and Farm Management |
| 609 | Economic Theory and Methods |
| 903 | Communication, Education, and Information Delivery |

## Outcome #7

### 1. Outcome Measures

Increased knowledge regarding the use of forest biomass as an energy source (Percentage increase in knowledge of attendees to workshops, field days, and demonstrations)

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Federal Planning processes occur regularly in western communities where a large portion of the surrounding lands are owned by the federal government. Most communities feel disenfranchised by the process and believe their voice is not heard while the voices of advocates and individuals from across the country dominate the input affecting the outcomes of the planning process that negatively affect the local economy as well as the ecological conditions of the surrounding landscapes. Communities have been looking for ways to improve the effectiveness of their voice.

**What has been done**
This past year OSU extension faculty have been members of the executive committee representing the county for lower Joseph Creek project working with the Blue Mtn ID Team. We have been involved in the whole NEPA process in development, selection and refinement of the alternatives; identifying the best options for both ecological and economic outcomes producing an

EIS covering 90,000 acres of watershed. Much of this work involves the potential to use forest residues and thinning materials as part of a proposed conversion of a coal fired power plant to biomass.

**Results**
The plan as approved will generate nearly 80-100MBF of commercial timber worth nearly $30 million.The 5400 acres of stand improvement can generate sufficient biomass for 115,000 tons of torrefied biomass.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 125 | Agroforestry |
| 403 | Waste Disposal, Recycling, and Reuse |
| 608 | Community Resource Planning and Development |
| 903 | Communication, Education, and Information Delivery |

**Outcome #8**

**1. Outcome Measures**

Increased knowledge of wave energy, particularly by coastal stakeholders (Percent increase in knowledge of attendees to workshops, field days, and demonstrations)

Not Reporting on this Outcome Measure

**Outcome #9**

**1. Outcome Measures**

A framework for the attrbutional LCA based on the ISO standards will be extended to include water use metrics. These metrics will be defined based on source (confined and unconfined aquifers, surface runoff and precipitation), quality, quantity (consumptive and degradative use) and water stress index (volume of withdrawals in the watershed compared to the annual recharge) by adapting several published methods. Metrics for nitrogen and phosphorous utilization will also be developed along similar lines.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

2015 0

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

While advantages of biofuel have been widely reported, studies also highlight the challenges in large scale production of biofuel. Cost of ethanol and process energy use in cellulosic ethanol plants are dependent on technologies used for conversion of feedstock. Process modeling can aid in identifying techno-economic bottlenecks in a production process. A comprehensive techno-economic analysis was performed for conversion of cellulosic feedstock to ethanol using some of the common pretreatment technologies: dilute acid, dilute alkali, hot water and steam explosion. Detailed process models incorporating feedstock handling, pretreatment, simultaneous saccharification and co-fermentation, ethanol recovery and downstream processing were developed using SuperPro Designer. Tall Fescue (Festuca arundinacea Schreb) was used as a model feedstock.

**What has been done**

Projected ethanol yields were 252.62, 255.80, 255.27 and 230.23 L/dry metric ton biomass for conversion process using dilute acid, dilute alkali, hot water and steam explosion pretreatment technologies respectively. Price of feedstock and cellulose enzymes were assumed as $50/metric ton and 0.517/kg broth (10% protein in broth, 600 FPU/g protein) respectively. Capital cost of ethanol plants processing 250,000 metric tons of feedstock/year was $1.92, $1.73, $1.72 and $1.70/L ethanol for process using dilute acid, dilute alkali, hot water and steam explosion pretreatment respectively. Ethanol production cost of $0.83, $0.88, $0.81 and $0.85/L ethanol was estimated for production process using dilute acid, dilute alkali, hot water and steam explosion pretreatment respectively. Water use in the production process using dilute acid, dilute alkali, hot water and steam explosion pretreatment was estimated 5.96, 6.07, 5.84 and 4.36 kg/L ethanol respectively.

**Results**

Ethanol price and energy use were highly dependent on process conditions used in the ethanol production plant. Potential for significant ethanol cost reductions exist in increasing pentose fermentation efficiency and reducing biomass and enzyme costs. The results demonstrated the importance of addressing the tradeoffs in capital costs, pretreatment and downstream processing technologies.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 402 | Engineering Systems and Equipment |
| 403 | Waste Disposal, Recycling, and Reuse |
| 511 | New and Improved Non-Food Products and Processes |
| 601 | Economics of Agricultural Production and Farm Management |

## Outcome #10

### 1. Outcome Measures

Biodiesel production from canola in the Pacific Northwest region will be used as a test case for the methodology developed for water use as an LCA component. Previously developed process models incorporating feedstock handling, pretreatment, transesterification, and coproduct utilization, waste water handling will be further refined to incorporate process efficiency variations. Cellulosic ethanol production from agricultural residues such as wheat straw and grass straw will be used to test the methodology. Algal biofuels production will be modeled based on algae biomass production using municipal waste water as a nutrient source willbe performed. Processing of algae would be based on recently suggested scheme that consists of harvesting algae biomass using flocculation and processing the resulting slurry into biocrude using hydrothermal liquefaction process and the upgraded into green diesel and jet fuel.

Not Reporting on this Outcome Measure

## Outcome #11

### 1. Outcome Measures

Examine idealized cases with LES utilizing simulation modeling compared with theoretical and field work. Construct a model to represent the local topography of an individual farm to investigate the coupled effects of topography, spatial variability in water application and wind turbines

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Deployment of renewable energy systems, particularly wind and solar, have not been studied sufficiently to determine potential impacts on agricultural production.

**What has been done**
LES models for wind turbines and solar panels are currently underdevelopment with the first year's data having been collected for solar panel impacts on forage pastures and the second year of data having been collected for wind turbines.

**Results**

Preliminary data suggests that solar arrays increase soil moisture within the array likely due to shielding. Relative humidity and temperature were not affected by the array but solar radiation and wind speed were significantly different inside and outside the array.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 131 | Alternative Uses of Land |
| 132 | Weather and Climate |
| 402 | Engineering Systems and Equipment |
| 601 | Economics of Agricultural Production and Farm Management |

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

**External factors which affected outcomes**

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

**Brief Explanation**

The significant drop in the price of fossil fuels has reduced efforts and funding toward alternative energy. Policy uncertainty regarding the RFS, production and investment credits, and a host of other policy drivers have reduced and in some cases eliminated investment in these technologies by capital markets.

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

**Evaluation Results**

We continue to advance knowledge concerning renewable energy. Recent adoption by some states of a Low Carbon Fuel policy has increased local interest in the provision of ethanol via cellulosic sugars from a variety of waste feedstocks and some purposely grown energy crops as rotation crops for existing cropping systems. Competing policy views on the relative impacts of renewable fuels on food and fuel pricing and policy uncertainty surrounding various incentives continues to reduce investment in these technologies from both federal agencies and private investors. Fossil fuel prices are currently not a driver for adoption of these technologies but climate change continues to generate some support, albeit limited. Work conducted at OSU continues to demonstrate that renewable energy via agricultural and forestry production remains as a viable alternative to reducing GHG.

**Key Items of Evaluation**

Policy challenges to deployment of a robust renewable energy program (RFS, PTC, ITC, etc) reduce capital investment and funding for research. Many technologies are ready for commercial deployment but a lack of funding in the face of declining fossil fuel prices has effectively tabled continued research and development activities.

## V(A). Planned Program (Summary)

**Program # 2**

**1. Name of the Planned Program**

Climate Change

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 101 | Appraisal of Soil Resources | 0% | | 5% | |
| 102 | Soil, Plant, Water, Nutrient Relationships | 0% | | 5% | |
| 103 | Management of Saline and Sodic Soils and Salinity | 9% | | 5% | |
| 112 | Watershed Protection and Management | 7% | | 5% | |
| 121 | Management of Range Resources | 15% | | 5% | |
| 122 | Management and Control of Forest and Range Fires | 8% | | 0% | |
| 123 | Management and Sustainability of Forest Resources | 17% | | 5% | |
| 125 | Agroforestry | 0% | | 5% | |
| 135 | Aquatic and Terrestrial Wildlife | 0% | | 10% | |
| 136 | Conservation of Biological Diversity | 0% | | 10% | |
| 212 | Pathogens and Nematodes Affecting Plants | 0% | | 5% | |
| 215 | Biological Control of Pests Affecting Plants | 0% | | 5% | |
| 303 | Genetic Improvement of Animals | 0% | | 5% | |
| 311 | Animal Diseases | 0% | | 5% | |
| 604 | Marketing and Distribution Practices | 0% | | 5% | |
| 605 | Natural Resource and Environmental Economics | 20% | | 5% | |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins | 0% | | 5% | |
| 723 | Hazards to Human Health and Safety | 24% | | 10% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 10.0 | 0.0 | 50.0 | 0.0 |
| **Actual Paid** | 9.0 | 0.0 | 75.0 | 0.0 |
| **Actual Volunteer** | 146.0 | 0.0 | 0.0 | 0.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 169772 | 0 | 957974 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 169772 | 0 | 8492402 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 95516 | 0 | 4409800 | 0 |

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

### 1. Brief description of the Activity

The program includes studies that focus on development of models of community-level responses to perturbations, population dynamics and habitat management for individual aquatic and terrestrial species, and development of methods for monitoring ecosystem changes. The experimental approaches that will be used to meet the specific objectives of these subprograms include field studies in the Oregon, the Pacific Northwest, the U.S., and abroad. In addition, the experimental approaches will also include controlled laboratory experiments and database/model development.

Theoretical and empirical models will be developed to examine land-use policies and impacts on water quality, wildlife habitat, watershed health, and other ecological indicators. Models will be used to examine how resource and agricultural policy affects major land use and cropping patterns, and how these may affect water quality.

Research is often carried out at field sites in the state, region, nation, or overseas. We will develop and use novel soil-water instrumentation, update and expand the reference evapotranspiration data currently available for Oregon, develop hydrologic models capable of simulating the interactions and processes between surface water and groundwater, conduct laboratory and field observations of physical and biological processes and functions, benthic macroinvertebrate community, numerical and statistical models play critical roles in understanding the driving principles of watershed and river ecosystems and linkages. Watershed and river basin scale resource simulation models and decision tools will be used to examine coupled natural and human systems and trajectories of change under alternative future scenarios.

OSUES's approach to climate change outreach will involve both traditional and non-traditional methods. We will integrate climate change content into existing educational programs, and address climate-related impacts such as drought and adverse storm damage response. Programs will also be developed and delivered, based on current research, which shows mitigation strategies and adaptations that can be accomplished now. For example, our forest geneticists are now developing revised seed zone maps that account for changing climate. This can assist forest owners and managers who are making planting decision today for forests that will grow for over 50 years and are likely to be under the effects of a

different climate 50 years from now.

Other activities will include volunteer-based programs such Climate Masters and Master naturalists, workshops and seminars, consultations and facilitations, web-based instructional programs, web sites, stand alone and web-based videos, publications of all types, mass media, and social networking.

In summary, we will:

- conduct research experiments
- collect data
- conduct assessments
- develop monitoring protocols
- develop products, curriculum resources
- conduct workshops & meetings
- present seminars and professional talks
- provide training
- deliver services
- provide counseling
- partnering
- facilitating

**2. Brief description of the target audience**

- The general public and those in natural resource-based communities, including growers, ranchers and fishermen
- The research community including scientists working in governmental, industrial, and academic sectors, including biomedical researchers, oceanographers, climatographers, virologists
- Growers, crop consultants, economists, extension faculty and researchers in the agricultural industry
- Ecologists and managers concerned with invasive species
- Salmonid and other fisheries
- State and federal natural resources management and regulatory agencies, including land managers
- Policy makers.
- Citizens in urban settings
- Engineering professionals
- Undergraduate and graduate students

The stakeholder involvement for the collaborative project will be in the form of active participation in the enhanced AgTools$^{TM}$ software to explore the economic potential for both mitigation and adaption strategies, using the existing advisory committees for the CAS and the departments to explore climate change related issues. As mentioned before, the policy and economic dimensions of climate change will be the topic of a forum sponsored by the Center for Agricultural and Environmental Policy (CAEP). The information and materials from this project will also be featured on a project "climate-driven changes in Oregon agriculture" website that is linked from the CAS home page and incorporates other climate science undertaken at OSU by the OCCRI. (http://oregonstate.edu/research/oregon-climate-change-research-institute-occri-0). Production system teams will provide information from the economic studies to their stakeholders at field days and through their online resource systems. Team 1 members plan to provide presentations to local production communities when opportunities arise. This process and format will be studies for its impacts and adopted by the other pilot teams with appropriate modifications. Our intent will be to have biannual forums.

**3. How was eXtension used?**

eXtension was not used in this program

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

### 1. Standard output measures

| 2015 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| Actual | 45776 | 121280 | 13733 | 36384 |

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

**Patent Applications Submitted**

Year: 2015

Actual: 0

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2015 | Extension | Research | Total |
|---|---|---|---|
| Actual | 10 | 55 | 0 |

### V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Developed new or better tools, technologies, practices, and models for understanding and managing water and irrigation systems, soil, food production (crops and animals) systems and land, pests and pathogens, natural resources, and land-use |
| 2 | Understand impacts of climate change on and responses of: food systems, land use, watersheds and water systems, species, habitat and ecosystems, genes, pests and pathogens, marine food webs |
| 3 | Evaluated resource management strategies and best practices for climate change mitigation, such as: a) chemical control, b) biological control, c) stock assessments, d) fishery management tools, e) nitrogen applications, f) water use efficiency, g) acres planted for carbon sequestration, h) coastal hazards, i) community resilience |
| 4 | Understand changes in societal views with regard to the value of habitats and conservation and how to manage these changes |
| 5 | Understand changes in ecosystems from carbon management strategies, soil microbial health, natural resource or ecosystem policies |
| 6 | New genotypes developed and planted that show enhanced adaptive capacity to climate change |
| 7 | Understand the role of international trade as a vehicle by which adaptations in global climate change can be made, such as: a) Key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; and b) Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large. |
| 8 | Conservation strategies adopted, for example: - Conservation bio-control strategies are implemented differently and active restoration strategies occur. Land owners and managers assess ecosystem services provided by their riparian restorations via a user-friendly web tool - Watershed councils, watershed stewards and Oregon Water Schools implement projects or programs based upon knowledge transmitted - Growers adopt improved, scale-dependent practices selected for various market niches with emphasis on reducing environmental degradation and impact. Commercial small farms will have more diverse and economically viable technologies and production techniques or systems available for their use - Growers implement drip irrigation and produce more marketable yields of onions, potatoes, and poplar trees than with furrow or sprinkler irrigation, and achieve efficient use of soil nitrate and the other available nitrogen sources under drip irrigation. - Generation of the viral vectors for grapevine disease control and functional genomics vectors have a potential for replacing current strategies of using chemical fungicides and bactericides with viral biocontrol strategies. |
| 9 | Participants who increase their knowledge of management practices and understanding of climate variability and change (Percentage). |
| 10 | Participants in educational programs who improve mitigation strategies for climate, such as reducing greenhouse gas emissions and increasing carbon sequestration in agricultural production and natural resource management systems (Percentage). |
| 11 | Clients who employ climate adaptation strategies or incorporate climate-based management practices (Percentage). |

| | |
|---|---|
| 12 | To assess the aggregate and distributional tradeoffs and consequences of policies, programs, and investments to enhance the adaptive capacity of our managed agroecosystems and thus reduce the downside of exposure and vulnerability to climate change and climate variability, to environmental change, and to changes in economic and policy-based incentives. This includes advancing fundamental knowledge about the flexibility and resilience of agricultural (managed) ecosystems to increased variability in climate -LCA and to better understand and expand technologies, innovation and systems that can adapt to increases in uncertainty in environmental conditions and increases in climate variability, regionally and within Oregon |
| 13 | To assess the technical and economic potential to engage in mitigation strategies for Oregon agricultural and managed resource sectors while quantifying the costs of alternative mitigation efforts for the agricultural and managed resource sectors in Oregon and the Pacific Northwest (PNW). |
| 14 | To provide educational opportunities for undergraduate students, graduate students, and stakeholders in the areas of climate change, risk, agroecosystem technologies, and interdisciplinary policy analysis. We will also enhance partnerships with industry and stakeholders for innovative and more resilient technologies, practices, policies and management strategies. |
| 15 | Develop an applied policy framework to quantify the direct and indirect impacts of alternative policy options and mandates for a sustainable biofuel system and explicitly address the economic and environmental tradeoffs at multiple scales. This will include a science-based methodology for assessing the tradeoffs (production levels, economic, environmental, social) associated with alternative management practices and technologies and a regional Computable general equilibrium model for assessing the regional impacts of changes in the PNW |

**Outcome #1**

**1. Outcome Measures**

Developed new or better tools, technologies, practices, and models for understanding and managing water and irrigation systems, soil, food production (crops and animals) systems and land, pests and pathogens, natural resources, and land-use

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Farmers in the western United States are increasingly affected by climate change through reduced snowmelt, higher temperatures, and drought (Van Horne et al., 2013). The Oregon Climate Change Research Institute (http://occri.net/) predicts a 50% reduction in summer water availability in Oregon within 50 years (Nolan and Daily, 2006). It is critical for the viability of farms in our region and the security of our food system to increase our knowledge and awareness of drought mitigation tools and strategies for farming with little or no irrigation. The goal of this project is to increase knowledge and awareness of dry farming management practices.

**What has been done**

A Dry Farming Demonstration site was established at the Oak Creek Center for Urban Horticulture on the campus of Oregon State University in Corvallis in 2015. A project webpage was created on the OSU Small Farms website (http://smallfarms.oregonstate.edu/dry-farming-demonstration) to assist in outreach and education. Articles on dry farming were published in newspapers, extension newsletters, and grower publications throughout the region. A Dry Farming Field Day held on August 3, 2015 was attended by more than 100 farmers and gardeners.

**Results**

Twenty-seven field day attendees participated in sensory evaluations. Dry-farmed watermelon and tomato were ranked higher for color, texture, and sweetness than irrigated crops of the same varieties.

Twenty-nine Dry Farming Field Day participants responded to a follow-up Qualtrics survey distributed by email and indicated that:

11% had a well run dry in 2015;

11% do not have water rights for irrigation;

Thirty-seven percent of survey respondents were farmers whose experience ranged from less than one year to 40 years. When these farmers were asked what additional information about dry farming would be most helpful for them, one-hundred percent of these respondents indicated that they wanted information about crops and varieties that do well with little or no irrigation, plant spacing under dry farming conditions, as well as soil and nutrient management. Ninety-three percent of all field day participants intend to apply what they learned at the field day on their land.

Since the field day a network of growers, including the Cascadia Drought Group, interested in dry farming and drought management strategies has come together. The multiple local, regional, and international citations the project has received in newspapers and grower publications has supported the growth of this group. In response to this need and grower interest, the dry farming demonstration will expand to three OSU Extension sites in Oregon in 2016 including Aurora, Corvallis, and Central Point. Ten growers will pilot the Participatory Dry Farming Research Project in 2017, with funds pending from Agricultural Research Foundation and Western SARE. Grower participants will be invited to a winter meeting to share successes and lessons learned in a collaborative environment. Their insights will inform the direction of future research.

## 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 103 | Management of Saline and Sodic Soils and Salinity |
| 112 | Watershed Protection and Management |

| | |
|---|---|
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #2**

**1. Outcome Measures**

Understand impacts of climate change on and responses of: food systems, land use, watersheds and water systems, species, habitat and ecosystems, genes, pests and pathogens, marine food webs

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Situation: Concerns for late season irrigation water supplies exist in the area for both crop and forage production. Technological advancement in irrigation water delivery and soil moisture monitoring equipment have gained the attention of natural resource managers and have offered local growers economic incentives to implement such technology in their operations.

**What has been done**
Action: Partnered with several OSU colleagues to pursue grant funds to conduct on-the-ground research and extension projects to increase adaptation of technology and improve water use efficiency and crop productivity.

**Results**
USDA-Agriculture and Food Research Initiative-Climate Change: Mitigation and Adaptation in Agriculture. Collaborated with Chad Mueller (OSU-EOARC), Tim Delcurto (OSU-EOARC), Austin Hawks (OSU Ag Program at EOU) and Gary Kiemnec (OSU Ag Program at EOU) and The Freshwater Trust on a grant to evaluate the effects of late-season deferred irrigation on forage

management. Role: coordinate extension outreach activities. Funding requested: $999,957.

USDA-NRCS Federal Conservation Innovation Grant. Collaborated with Chad Higgins (OSU-Biological and Environmental Engineering), Chris Hoyle (OSU Mech. Eng) and Charles Hillyer (OSU-BEE) on a grant to evaluate an optimal variable rate irrigation design tool. Role: coordinate and participate in local field evaluation of the design tool in NE Oregon center pivot irrigated fields (2). Funding requested: $288,999.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 103 | Management of Saline and Sodic Soils and Salinity |
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 605 | Natural Resource and Environmental Economics |

**Outcome #3**

**1. Outcome Measures**

Evaluated resource management strategies and best practices for climate change mitigation, such as: a) chemical control, b) biological control, c) stock assessments, d) fishery management tools, e) nitrogen applications, f) water use efficiency, g) acres planted for carbon sequestration, h) coastal hazards, i) community resilience

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Situation: Pacific Northwest summer fallow production systems have historically provided a means to recharge soil moisture from fall and winter precipitation. Tillage has then been used to minimize moisture loss during the summer due to capillary flow and evaporation, or from transpiration by weeds. However, these tillage practices degrade soil physical properties and pose a threat of increased soil erosion. No-tillage chemical fallow systems can reduce soil erosion but tend to increase the evaporation losses of seed zone soil moisture. OSU established an on-farm large scale research effort in the fall of 2012 with a local farm to increase understanding of the effects of types of fallow tillage and its impact on seed zone moisture, weed control, yields and profitability. Various growers, researchers and extension faculty have participated in the project over its life, and have made important contributions to the overall success of the project.

**What has been done**

Activities: The following research efforts and related extension activities-
i.Four year replicated on-farm research comparing primarily 3 different fallow systems ranging from no-tillage, reduced tillage using undercutter sweep tillage, and conventional mulch tillage.
ii.Year 3 and 4 of the study, 3 additional treatments were added to the study and an additional second location in Davenport, Washington, was added as the research expanded to include additional researchers and funding.
iii.Umatilla County Weed and Crop Tour presented the research findings to local farmers, field consultants, researchers, and agency personnel.

**Results**

Results: The adoption of conservation farming practices continues to develop across the area with both reduced tillage practices and no till. These changes represent an annual soil loss savings of about 422,000 tons, which at $6/ton for a soil value equals $2.5 million in savings.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 605 | Natural Resource and Environmental Economics |

**Outcome #4**

**1. Outcome Measures**

Understand changes in societal views with regard to the value of habitats and conservation and how to manage these changes

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
The sagebrush ecosystem is facing critical challenges that have reduced its size by 50% in the last 150 years. As a result, numerous wildlife species reliant on this ecosystem have declined. When declines in populations of sensitive wildlife species interface with ecosystem problems, the historical inertia of species-driven regulatory policy (e.g. the Endangered Species Act) can elevate short-term wildlife concerns over long-term ecosystem management priorities.

**What has been done**
Developed and published a paper that differentiated species vs. ecosystem problems, argued for the importance of ecosystem management in maintaining wildlife populations, and proposed an ecologically-based framework for merging the needs of sensitive wildlife species with ecosystem management imperatives using state-and-transition theory. we then collaborated with local, state, and national conservation partners to help implement the management models and ideas developed in this publication.

**Results**
Models and principles developed in conjunction with the publication are being directly used as the basis for habitat management for greater sage-grouse in Programmatic Candidate Conservation Agreements with Assurances covering nearly 3.5 million acres of sage-grouse habitat in 7 Oregon counties. This effort was nationally recognized by the Public Lands Foundation. These agreements, between private landowners and the US Fish and Wildlife Service, limit regulatory consequences to private landowners if sage-grouse are listed under the Endangered Species Act. This and similar efforts were cited a major factor contributing to the recent US Fish and Wildlife Service decision to not list the greater sage-grouse under the provisions of the Endangered Species Act. These same models and principles were used to guide vegetation management and to develop an ecosystem management-based mitigation framework by the task force that prepared an all lands/all threats sage-grouse management plan for the state of Oregon. In addition, collaborators and I were asked by the Natural Resources Conservation Service to participate in making and producing an NRCS video to highlight the use of succession-based models in the management of sage-grouse habitat. This body of work has been used by the NRCS-Sage-grouse initiative to inform conservation efforts in 11 western states.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|

| | |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 136 | Conservation of Biological Diversity |
| 605 | Natural Resource and Environmental Economics |

**Outcome #5**

**1. Outcome Measures**

Understand changes in ecosystems from carbon management strategies, soil microbial health, natural resource or ecosystem policies

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Climate variability and change has the potential to influence how fish use coastal and marine habitats by altering temperature, food availability, and structure. Such changes could alter migration patterns of marine and anadromous fishes. Understanding migration patterns and habitat use of marine and anadromous fishes is an integral component of successful conservation and management. Additionally, effective and sustainable management depends on knowledge of spawning locations and their relative contributions to marine fish populations.

**What has been done**
Field collections were combined with genetic and otolith analyses to provide novel information on larval dispersal in Pacific cod and migration patterns of salmonid populations in Alaska, Washington, and Oregon.

**Results**
The "retirement", or cessation of annual ocean migrations, of larger, older Dolly Varden trout was identified for the first time in an Alaskan population. This finding that fish can "retire" demonstrates that there is still much we have to learn about how commercially and culturally important species survive.

Evidence for non-random distributions of larval Pacific cod in the Bering Sea was identified. The distribution of larval sources reflected interannual variation in regional oceanography, which highlights how environmental variation influences animal distributions, including very early life stages. Furthermore, the results indicate that the relative contribution of local spawning areas could vary across years.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 605 | Natural Resource and Environmental Economics |

**Outcome #6**

**1. Outcome Measures**

New genotypes developed and planted that show enhanced adaptive capacity to climate change

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Climate change and increasing human population together with decrease in crop cultivation acreage, in addition to economic and social changes in our ecosystem, is demanding researchers to tap into new resources of genetic gains in crop species leading to increased yield and production. The traits like drought and salinity tolerance, increased grain and fruit yield and quality, resistance to pests and pathogens and improving pre and post-harvest yield are most sought after. Therefore, exploring new genetic resources from wild ancestors of modern crop varieties and training new age of researchers in use of cutting edge genomics, molecular breeding, genetics and bioinformatics are key to successful future plant and agriculture improvement programs both and the national and international levels.

**What has been done**
We undertook genomics and bioinformatics analysis of exploring genome-wide transcription profiling of genes and genetic variation from major crops under various treatment conditions.

Developed online bioinformatics platforms and resources to carrying out in-silico analysis of genomics and genetics data.

**Results**
Following crops were studied for their response to various abiotic and biotic treatment response to find novel candidate genes, pathways and genetic variations associated to desired traits.
oRice (10 accessions): Drought, Salinity, Pathogen-Rhizoctonia solani (sheath blight disease) response
oWheat (9 accessions): Drought and Salinity response
oPoplar (5 accessions of Bioenergy Feedstock): Cold, Heat, Drought and Salinity
Developed online bioinformatics platforms and resources to carryout in-silico analysis of data for :
oPlant Reactome: metabolic and regulatory pathways from 58 plant species
oMetabolic networks for rice, maize, sorghum, grape, strawberry, Eucalyptus
oPlant Genome annotation workflows and database called Planteome

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #7**

**1. Outcome Measures**

Understand the role of international trade as a vehicle by which adaptations in global climate change can be made, such as: a) Key relationships that tie climate change to the distribution of crop yields, comparative advantage, geography, and international trade; and b) Numerical estimates regarding how climate change will affect crop prices, production costs, and the economic welfare of producers, consumers, and society at large.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

2015 0

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

Climate change and enhanced climate variability will have differing impacts on agricultural sectors worldwide. Whether in the form of increased intra-seasonal variability, severe heat waves, long-term drought or warmer winters, farmers and growers need to be cognizant of the risks and opportunities that future weather patterns may bring to yields and profitability, as well as the possible environmental outcomes associated with changes in management regimes. Despite advances in applied research and analysis over the past half century, making informed management decisions based on integrating climate and environmental science findings at the farm scale remains a challenge. Critical information and data are often missing, and thus the consequences of changes in management practices across many dimensions are not easily identified. Decision tools and modules such as AgBiz Logic, provide essential analytical output for global and national efforts labeled "climate-smart agriculture" which focus on making farms and farmers more resilient to a changing climate. These decision support tools are at the very heart of the recommendations called for in the recent U.S. Government Accountability Office report 14-755 (U.S. GAO 2014), which speaks to USDA?s ongoing efforts to better communicate information to growers in a timely downscaled manner.

**What has been done**

Improved data and methods have been developed and used to assess climate change impacts and adaptation options in the western US, specifically in the PNW agricultural sectors. Results of the research have been made available through peer-reviewed publications, research reports, conference presentations, on-line media and interviews with the press.

**Results**

Improved methods provide the capability to assess system-specific adaptations to climate changes. Research shows how bio-physical data and models can be combined more effectively with economic data and models to produce better assessments of adaptation strategies. Climate change impacts are found to be highly variable, depending on type of system and location. Impacts can be both positive and negative. Various adaptations have been evaluated, including changes in cropping system, use of alternative management practices, and integration of crops and livestock systems.

Improved methods for development of future plausible scenarios provide more credible assessments of climate change impacts and the value of adaptations. Analysis using these methods show that changes in technology and economic conditions may be as important as climate changes between now and mid-century. After mid-century, climate impacts increase and are likely to become increasingly important.

Three key elements are required to improve the capability to make better management and ultimately policy decisions: (1) timely and accurate data on climate variability and its impact on yield and cost projections; (2) scientific understanding of the agro-ecological system at the farm scale; and (3) incorporation of those two elements into knowledge products that meet the needs of growers and policy decision makers. The increasing utilization of precision farming and mobile technologies, together with improvements in data management software, offer expanding opportunities for an integrated data platform that links farm-level management decisions and resulting behavioral changes to site-specific biophysical data and analytical tools. Through the use of data technologies, farm-level information can be integrated with publically available data at

the landscape scale for supporting science-based policy and sustainable management of agricultural landscapes.

Our results show how decision support tools can be designed to address the farm-scale tradeoffs associated with changes in climatic conditions, and how these farm-scale tools could be linked with regional based analyses to scale up to the information needed for better science-based policy. We illustrate how the three key elements noted above can be addressed within the AgBiz LogicTM platform and decision-support framework developed to aid growers in evaluating current and alternative management systems under future climate scenarios. By incorporating both climate change and environmental outcomes, these decision tools can be used to evaluate climate smart options. Our illustrative case study reflects the dryland wheat producing area of the U.S. Pacific Northwest.

Decision tools and modules such as AgBiz Logic, provide essential analytical output for global and national efforts labeled "climate-smart agriculture" which focus on making farms and farmers more resilient to a changing climate. These decision support tools are at the very heart of the recommendations called for in the recent U.S. Government Accountability Office report 14-755 (U.S. GAO 2014), which speaks to USDA's ongoing efforts to better communicate information to growers in a timely downscaled manner.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 123 | Management and Sustainability of Forest Resources |
| 125 | Agroforestry |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 215 | Biological Control of Pests Affecting Plants |
| 311 | Animal Diseases |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |

## Outcome #8

### 1. Outcome Measures

Conservation strategies adopted, for example: - Conservation bio-control strategies are implemented differently and active restoration strategies occur. Land owners and managers assess ecosystem services provided by their riparian restorations via a user-friendly web tool - Watershed councils, watershed stewards and Oregon Water Schools implement projects or programs based upon knowledge transmitted - Growers adopt improved, scale-dependent practices selected for various market niches with emphasis on reducing environmental degradation and impact.

Commercial small farms will have more diverse and economically viable technologies and production techniques or systems available for their use - Growers implement drip irrigation and produce more marketable yields of onions, potatoes, and poplar trees than with furrow or sprinkler irrigation, and achieve efficient use of soil nitrate and the other available nitrogen sources under drip irrigation. - Generation of the viral vectors for grapevine disease control and functional genomics vectors have a potential for replacing current strategies of using chemical fungicides and bactericides with viral biocontrol strategies.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Conventional and organic farmers utilizing organic waste products and cover crops as fertilizers only had access to general published estimates of N mineralization. Organic fertilizers are also expensive and contain different nutrient ratios. This made it difficult for farmers to match organic fertilizer rates with soil requirements and identify the most cost-effective fertilizer program. Total N content and plant-available N (PAN) content of cover crops is difficult to estimate in the field. Growers also lacked tools to compare the cost of cover cropping to the cost of fertilizers when developing nutrient management plans. In collaboration with Dan Sullivan (Department of Crop and Soil Science) I am developing methods and tools for growers to estimate PAN from cover crops and organic fertilizers and to identify balanced and cost effective nutrient management plans.

**What has been done**
Most recently a UI Soil Scientist secured funding to develop a similar N mineralization calculator for cover crops in Idaho, and a team In 2012 NRCS and Oregon Tilth were awarded a WSARE PDP grant to teach conservationists in the PNW to use the OSU calculator. With funding from this grant, Andrews and Sullivan have been teaching nutrient management workshops for agricultural professionals in California, Oregon, Washington. In 2008 we developed and launched the OSU Organic Fertilizer Calculator. It allowed growers to determine the most cost effective and balanced fertilizer program for all nutrients and integrated an existing PAN model for organic fertilizers (Sullivan). With grant funding from WSARE, we compared field methods for estimating total N content of cover crops. I also proved the concept that total N analysis of a sample with a mixture of cover crop species could be used to estimate cover crop PAN. With funding from an OSU Special Grant, Sullivan and I validated a published PAN model for crop residues with laboratory and field trials. Jim Julian (OSU Agricultural and Resource Economics Department)

and I developed an economic spreadsheet to estimate the cost of using cover crops. The cover crop PAN model and economic spreadsheet were combined with the original fertilizer calculator to develop the OSU Organic Fertilizer and Cover Crop Calculator. The website also includes cover crop field sampling instructions. In 2014 a modified version of the calculator was developed for small farms and gardens.

**Results**

The original Organic Fertilizer Calculator was launched in 2008 and extended to cover crops in 2010. From 2008-2010 it had over 1600 registered users. From 2010-2013 more than 840 people from 47 countries have registered to use the expanded Organic Fertilizer and Cover Crop Calculator. More than 540 were in the U.S. with Oregon (149), Washington (83) and California (49) having the most registered users. Over 160,000 acres are managed by people registered to use the calculator. If 25% of the registered users save $50/acre/year on reduced fertilizer costs or increased yields, the estimated annual economic impact of the new calculator is more than $2 million. Most registrants identified themselves as farmers (291 or 36%) or other agricultural professionals (318 or 39%). 137 students (17%) and 60 gardeners (7%) also registered. At the end of 2010, 19 agricultural professionals responded to an online user survey. The main users were Extension faculty and conservation planners. They rated the overall helpfulness of the calculator at 4.4/5. 8 use it in their teaching, 11 in their extension work and 7 in their research.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 125 | Agroforestry |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |

**Outcome #9**

**1. Outcome Measures**

Participants who increase their knowledge of management practices and understanding of climate variability and change (Percentage).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 91 |

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

**Issue (Who cares and Why)**
Small acreage landowners have a significant impact on water quality in the Willamette Valley. Many agriculture and natural resource professionals agree that small farms are an underserved population with a demanding conservation need. Manure runoff and sedimentation from small livestock operations, infestation of invasive weed species and degradation of riparian areas are identified needs that require landowner awareness.

**What has been done**
I have developed curriculum and training materials and provided instruction for a variety of workshops and trainings for the small acreage landowners including Living on the Land: Stewardship for Small Acreages, Horses and Mud and Rural Living Basics.

**Results**
Longitudinal survey data collected from Horses and Mud participants nearly a year after the workshops show that participants readily adopted management practices as a result of the workshops. Over 90% of participants implemented at least one or more management practice on their property as a result of the workshop. Thirty-eight percent of the participants implemented 4 or more practices. Seventy-two percent of the participants still plan to implement practices. Of interest, 66 % of the participants indicated that "protecting the environment" was one of their motivations to complete management practices. The combination of well-targeted educational materials and motivated landowners is leading to better managed horse farms and improved water quality. In 2006-2009, 253 landowners participated in the Living on the Land training series. The participants were asked 7 to 11 months after the training if they had implemented any of the 10 management practices highlighted in the series. Such practices included improved pasture management, testing soil before applying fertilizer, actively manage invasive weeds, and composting livestock manure. Results indicated that 91% of the landowners implemented at least one new management practice on their farm as a result of the workshop series, 61% implemented 3 or more new practices within 11 months of completing the workshop series and 89% of the participants told friends and neighbors about the practices they learned during the workshop series. As a result of attending the workshop series, 32% of the participants contacted their local Soil and Water Conservation District or Natural Resource Conservation Service for further technical assistance or funding opportunities to address concerns on their land.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 103 | Management of Saline and Sodic Soils and Salinity |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 123 | Management and Sustainability of Forest Resources |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 303 | Genetic Improvement of Animals |
| 311 | Animal Diseases |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #10**

**1. Outcome Measures**

Participants in educational programs who improve mitigation strategies for climate, such as reducing greenhouse gas emissions and increasing carbon sequestration in agricultural production and natural resource management systems (Percentage).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Situation: Increasing vineyard efficiency and decreasing input costs are paramount to a sustainable production system that is also environmentally beneficial when fuel and pesticide use is reduced and the vineyard ecology is enhanced. The Oregon winegrape industry markets its wines based on this sustainability to increase sales and hopes to increase product value while decreasing cost of production in the vineyard without compromising quality. Extension outreach and applied, interdisciplinary research are developed to help address sustainability in winegrape production. A video summarizes my work with my projects in vineyard sustainability: Powered by Orange. http://www.youtube.com/user/oregonstateuniv#play/uploads/4/zXriAWcH-14. For all projects outlined below, information is extended to the industry through a platform of workshops, newsletters, and seminars.

**What has been done**

Research & Extension Effort/Methods: This trial was conducted to determine alternative methods by which growers can conserve soil moisture, conduct non-chemical weed control, increase vine nutrition through organic sources, and increase vine health during the first few years of vineyard establishment. This trial began in spring 2009 and will be carried through 2015. This trial was developed because there was increasing interest by growers to switch to non-chemical means of weed control and identify ways in which cover crops can be used to enhance vine nutrition rather than supplementing with conventional fertilizers. This work is being conducted in a commercial vineyard, and input from growers was sought during development of the study. Two grower field meetings and one workshop were held at the research site to explain the trial and the findings. Information from this study has been incorporated into several invited seminars regarding cover crop management and vineyard sustainability. The first manuscript from this work was published in HortTechnology, April 2011. Drafts of two other manuscripts are in progress and one is near submission as of January 2015.

**Results**

Results and Impact: The four years of this trial indicated that cover crops can be used in innovative ways to impact vine growth, soil moisture and soil health. When cover crop was mowed and used as a mulch layer in the vine row, it effectively increased soil moisture conservation, reduced weed growth, and increased vine canopy growth, root development and increased fruitfulness. This indicates that cover crops can be grown and managed in different ways to reduce inputs of herbicide, fertilizers and irrigation. We estimate a potential cost savings of $82/acre in reduced herbicide use, $75/acre in reduced fertilizers use, and $3,000/acre in not having to install an irrigation system.

A result of this work has been the development of an innovative new Extension publication, Grapevine Nutrition, an online module published in 2011 by OSU Extension Publishing. This module is designed to educate the industry on vineyard nutrient management. This information will help growers to understand research on new and alternative management methods for sustainable production. Summaries of the project was provided to industry through several events: workshops, oral presentation at the OSU Viticulture & Enology Research Colloquium, a poster at the International Cool Climate Symposium and National Conference of the American Society for Enology and Viticulture, an oral presentation at the Intervitis/Interfructa , several Willamette Valley Viticulture Technical Group meetings, and during lectures/discussions of the Extension online course. An industry survey was conducted of the Oregon winegrape industry from 2012-2015 to determine the management practices that industry currently uses in vineyard floor management. This quantified changes in grower practices over time.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

## Outcome #11

### 1. Outcome Measures

Clients who employ climate adaptation strategies or incorporate climate-based management practices (Percentage).

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

Beef cattle producers in Oregon have access to the USDA Natural Resource Conservation Service Conservation Stewardship Program (CSP) funds. These funds allow them to maintain and improve their existing conservation systems and adopt additional conservation activities to address priority resources concerns. One CSP requirement is that participants must host a field day that highlights land stewardship improvements implemented with CSP funds. Additionally, they must host a workshop targeting natural resource conservation.

**What has been done**

The goal of this project is to co-sponsor a Grazing Field Day to increase beef cattle producers? skills and awareness related to photo-monitoring, plant identification, and forage production.

**Results**
The Grazing Field Day satisfied one beef cattle producers' requirements for an educational event under CSP conservation stewardship program. Not fulfilling the requirement could result in program termination.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 605 | Natural Resource and Environmental Economics |

**Outcome #12**

**1. Outcome Measures**

To assess the aggregate and distributional tradeoffs and consequences of policies, programs, and investments to enhance the adaptive capacity of our managed agroecosystems and thus reduce the downside of exposure and vulnerability to climate change and climate variability, to environmental change, and to changes in economic and policy-based incentives. This includes advancing fundamental knowledge about the flexibility and resilience of agricultural (managed) ecosystems to increased variability in climate -LCA and to better understand and expand technologies, innovation and systems that can adapt to increases in uncertainty in environmental conditions and increases in climate variability, regionally and within Oregon

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Various stakeholders, including farmers, farm organizations, public and private sector entities, and the general public, have a need for better information about the likely impacts of climate change on food production, and what actions can be taken to adapt to climate change.

**What has been done**
Improved data and methods have been developed and used to assess climate change impacts and adaptation options in major food producing regions of the world. Results of the research have been made available through 11 peer-reviewed publications, research reports, seven conference presentations, on-line media and interviews with the press.

**Results**
Improved methods provide the capability to assess system-specific adaptations to climate changes. Research shows how bio-physical data and models can be combined more effectively with economic data and models to produce better assessments of adaptation strategies. Climate change impacts are found to be highly variable, depending on type of system and location. Impacts can be both positive and negative. Various adaptations have been evaluated, including changes in cropping system, use of alternative management practices, and integration of crops and livestock systems.

Improved methods for development of future plausible scenarios provide more credible assessments of climate change impacts and the value of adaptations. Analysis using these methods show that changes in technology and economic conditions may be as important as climate changes between now and mid-century. After mid-century, climate impacts increase and are likely to become increasingly important.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 723 | Hazards to Human Health and Safety |

## Outcome #13

### 1. Outcome Measures

To assess the technical and economic potential to engage in mitigation strategies for Oregon agricultural and managed resource sectors while quantifying the costs of alternative mitigation efforts for the agricultural and managed resource sectors in Oregon and the Pacific Northwest (PNW).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Soil carbon (C) sequestration is a major agriculturally based strategy for mitigating rising atmospheric concentrations of greenhouse gases. Soil organic carbon (SOC) levels are dynamic, depending on C additions and losses. Carbon is added from unharvested plant residues and roots, organic amendments, and erosional deposits. Carbon is lost through decomposition of organic materials and C transport via soil erosion. Conversion of native lands to agricultural production results in a 20 to 60% loss of SOC within 40 to 50 years.

**What has been done**
Overall objectives under REACCH regarding SOC are to: (1) continue to quantify agricultural impacts on SOC sequestration for dryland cropping systems in different agroecological zones (AEZs) of the Pacific Northwest; (2) characterize site-specific changes in SOC (0 to 1.53 m) due to management practices within fields typical of the region; and (3) assess chemical, physical, and biological methods of measuring active SOC pools.

**Results**
They reported SOC changes under different soil management scenarios: native conversion, adoption of NT, and use of a mixed perennial-annual rotation (Table 1). These analyses showed that 75% of converted native land lost at least 0.14 to 0.70 Mg C ha-1 yr-1 over an average of 55 to 74 years depending on AEZ. Converting from CT to NT was predicted to increase SOC at least 0.12 to 0.21 Mg C ha-1 yr-1 over 10 to 12 years in 75% of studies analyzed and was also AEZ specific. Compared to annual cropping, mixed perennial-annual systems would be expected to gain at least 0.69 Mg C ha-1 yr-1 over 12 years in 75% of AEZ
2 (annual cropping) sites. Regional assessments of active SOM pools in long-term REACCH study areas in each of three dry land AEZs as well as an irrigated site were initiated in 2013.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|

| | |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 103 | Management of Saline and Sodic Soils and Salinity |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 311 | Animal Diseases |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #14**

**1. Outcome Measures**

To provide educational opportunities for undergraduate students, graduate students, and stakeholders in the areas of climate change, risk, agroecosystem technologies, and interdisciplinary policy analysis. We will also enhance partnerships with industry and stakeholders for innovative and more resilient technologies, practices, policies and management strategies.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Many beginning farmers do not come from an agricultural background and do not have agricultural training. There is a need for integrated beginning farmer training in Oregon to serve this large but historically underserved audience.

**What has been done**

In collaboration with Small Farms Team members we are developing OSU's Growing Farms curriculum. The series integrates farm business management with principles of holistic farm management. Participants receive an extensive informational handbook and Growing Farms Planning Workbook that supports development of their farm plan. From 2012-2013 we have been working as a team to create online curriculum. In 2015 we plan to implement a flipped classroom and fully utilize the online material. Curriculum and resources are developed collaboratively by the Small Farms team and collaborators. The course has been taught in five regions in Oregon. Instruction is provided by extension agents, other agricultural professionals and experienced small scale farmers. Meals allow time for participants to interact with each other, meet instructors and develop a sense of community.

**Results**

From 2009-2015, 149 have attended the series at NWREC. At least 24 farms and three non-profit organizations have given input into curriculum development, and many have served as course instructors or farm tour hosts. Evaluations from two sites in 2010 show that most participants felt better prepared to: establish goals, values and a mission to guide the farm business (97%); take the steps to set up a farm business (97%); establish record keeping and accounting systems (89%); select appropriate equipment (87%); find regulations and licenses required for their farm (82%). 90% plan to start or expand a farm business as a result of the course, 7% decided not to pursue a farm business as a result of the course. In 2011 overall quality of the course was rated 4.4/5, and 65% said they plan to start a new farm business as a result of taking the course. All participants felt better able to evaluate marketing options, 96% of participants felt better able to establish goals, values and a farm mission, select appropriate equipment, and evaluate and manage their soils, and 91% felt better able to manage pests and take the steps to set up a farm business.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 101 | Appraisal of Soil Resources |
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 103 | Management of Saline and Sodic Soils and Salinity |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 123 | Management and Sustainability of Forest Resources |
| 125 | Agroforestry |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 212 | Pathogens and Nematodes Affecting Plants |
| 215 | Biological Control of Pests Affecting Plants |
| 303 | Genetic Improvement of Animals |
| 311 | Animal Diseases |
| 604 | Marketing and Distribution Practices |
| 605 | Natural Resource and Environmental Economics |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |

723 Hazards to Human Health and Safety

**Outcome #15**

**1. Outcome Measures**

Develop an applied policy framework to quantify the direct and indirect impacts of alternative policy options and mandates for a sustainable biofuel system and explicitly address the economic and environmental tradeoffs at multiple scales. This will include a science-based methodology for assessing the tradeoffs (production levels, economic, environmental, social) associated with alternative management practices and technologies and a regional Computable general equilibrium model for assessing the regional impacts of changes in the PNW

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
One of the issues associated with biofuel production that is poorly understood is the impact to water resources as a result of producing feedstocks and converting feedstocks to fuels. This work hopes to begin analyzing this concept.

**What has been done**
We develop economic models (one theoretical, one empirical) that uncover several tradeoffs involving water-use decision-making in the midst of climate change. One tradeoff focuses on competition for water among different economic sectors. A second tradeoff examines the possibility that certain types of agricultural investments can offset water use. A third tradeoff explores the possibility that the rest of the world can be a source of supply or demand for a country's water-using commodities. The fourth tradeoff concerns how variability in water supplies influences farmer decision-making. We show conditions under which trade liberalization affect water use.

In the second, empirical paper, we show that trade liberalization leads to greater global water savings, making it a potentially important adaptation measure to a changing climate, although future work is needed to distinguish high resolution crop water use, water stress, and commodity transfers.

**Results**

Publications in the past year:
Megan Konar, Jeff Reimer, Zekarias Hussein, Naota Hanasaki. 2016. ?The Water Footprint of Staple Crop Trade under Climate and Policy Scenarios.? Environmental Research Letters 11:1-15.

Qian Dang, Megan Konar, Jeff Reimer, Giuliano Di Baldassarre, Xiaowen Lin, and Ruijie Zeng. 2016. ?A Theoretical Model of Water and Trade.? Advances in Water Resources 89:32-41.

Conference presentations
A Theoretical Model of Water and Trade? collaborator on poster presented at American Geophysical Union meetings Fall 2015 (with Qian Dang, Megan Konar, Giuliano Di Baldassarre, Xiaowen Lin, Ruijie Zeng)

Properties of Trade Across Scales? collaborator on poster presented at American Geophysical Union meetings Fall 2015 (with Xiaowen Lin, Megan Konar, Benjamin Ruddell, Richard Rushforth)

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 112 | Watershed Protection and Management |
| 121 | Management of Range Resources |
| 122 | Management and Control of Forest and Range Fires |
| 135 | Aquatic and Terrestrial Wildlife |
| 136 | Conservation of Biological Diversity |
| 605 | Natural Resource and Environmental Economics |

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

**External factors which affected outcomes**

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

**Brief Explanation**

Internationally, the Paris Accords have drawn attention to climate change and the need to begin now to address cataclysmic changes that are likely to occur with inaction. Confoundedly, Congress continues to delay or ignore the impacts that will occur to the food

supply, water regimes, biodiversity, and epidemics of new pathogens and human health risks. This inattention and derision of those who would bring attention to this issue will continue to impact the availability of research funds and adaptive technologies to fight climate change in the foreseeable future.

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

### Evaluation Results

The impact of climate change on agricultural production practices and natural systems functions is only now beginning to be understood. With drought conditions prevalent across much of the west, water management and conservation has become a critical issues as people, endangered species and agricultural producers compete for the same resource. While we are making significant progress, some impacts may already be beyond our ability to react with sufficient speed to mitigate these impacts.

Many of the changes set in motion are unavoidable, caused by greenhouse gases already emitted (Solomon et al. 2009), though they may be temporarily obscured by the Northwest's highly variable climate (Hawkins and Sutton 2009; Deser et al. 2012). What risks will a changing climate bring for the region as a whole and for specific sectors and locations? What strategies are emerging for evaluating and altering management of regional water and energy supplies, infrastructure, transportation, health, and ecological and agricultural systems to address these risks? To what extent is the region preparing?

Much of our works has been to begin to synthesize currently available information to provide answers to these questions. It focuses on impacts that matter for the region as a whole, chosen with an eye toward the likely major drivers of regional change and consequences of highest regional and local importance.

Our work will provide an assessment of existing knowledge that builds on and augments previous assessments (e.g., Climate Impacts Group 2009, Oregon Climate Change Research Institute 2010) and draws on a wealth of resources from local government and state agency reports to academic peer-reviewed journal articles. It is intended to be a resource for preparing the Northwest for climate change.

### Key Items of Evaluation

While we can do our best to discern the most likely consequences of climate change for NW ecosystems and communities, the ultimate consequences of the changes now in motion remain partially contingent on future societal actions and choices. Whether the consequences of the climate impacts outlined in this report are severe or mild depends in part on the degree to which regional social, economic, and infrastructural systems are adjusted to align with the changing climate, and the degree to which natural systems are provided with the room, flexibility, and capacity to respond. The regional consequences of climate change will also be strongly shaped by past choices--of what to build where, what to grow where--and by the laws, institutions, and procedures that shape how natural resources are managed and allocated, risks from natural hazards are identified, and trade-offs among conflicting objectives resolved.

## V(A). Planned Program (Summary)

**Program # 3**

**1. Name of the Planned Program**

Global Food Security and Hunger

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships | 9% | | 5% | |
| 111 | Conservation and Efficient Use of Water | 7% | | 5% | |
| 121 | Management of Range Resources | 11% | | 0% | |
| 202 | Plant Genetic Resources | 0% | | 15% | |
| 204 | Plant Product Quality and Utility (Preharvest) | 9% | | 5% | |
| 205 | Plant Management Systems | 9% | | 5% | |
| 206 | Basic Plant Biology | 0% | | 5% | |
| 216 | Integrated Pest Management Systems | 6% | | 10% | |
| 301 | Reproductive Performance of Animals | 5% | | 5% | |
| 302 | Nutrient Utilization in Animals | 3% | | 0% | |
| 307 | Animal Management Systems | 9% | | 5% | |
| 311 | Animal Diseases | 0% | | 10% | |
| 501 | New and Improved Food Processing Technologies | 5% | | 5% | |
| 502 | New and Improved Food Products | 6% | | 5% | |
| 601 | Economics of Agricultural Production and Farm Management | 5% | | 10% | |
| 602 | Business Management, Finance, and Taxation | 7% | | 0% | |
| 603 | Market Economics | 3% | | 10% | |
| 903 | Communication, Education, and Information Delivery | 6% | | 0% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |

| | | | | |
|---|---|---|---|---|
| **Plan** | 60.0 | 0.0 | 65.0 | 0.0 |
| **Actual Paid** | 61.0 | 0.0 | 85.0 | 0.0 |
| **Actual Volunteer** | 1932.0 | 0.0 | 0.0 | 0.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 1057068 | 0 | 1716753 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 1057068 | 0 | 15212956 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 1670572 | 0 | 18420360 | 0 |

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

### 1. Brief description of the Activity

In Oregon there are over 38,000 farms producing crops on over 16 million acres. Because 25% of Oregon's economy is based on agriculture; successful breeding programs directly influence and affect the success of a good portion of that value. Fruits, nuts, berries, vegetables, seed and specialty crops are produced on over 320,000 acres, and production has been increasing by 12% per year, generating $30-50 million per year. Cereal grains, potatoes and row crops account for over 10% of agricultural farm gate value in a typical year. The Oregon greenhouse and nursery industry typically accounts for approximately 15% of farm gate value annually.

Oregon crops are hosts to a wide variety of pathogens, pests, and stresses for which durable resistance genes are actively sought. At the same time, allelic variation in genes and gene networks associated with plant growth and development are targets for optimization in order to ensure maximum plasticity, productivity, and efficiency. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal).

The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs.

Organic, value-added, and technological (bio-based, information-centered, robotic, nanotechnology, etc.) approaches complement conventional agriculture. By utilizing contemporary research tools in agronomy, animal or soil science, plant nutrition and pest management, and molecular or genetic techniques, this program will develop improved practices for crop and animal production systems. New or enhanced techniques and information will enhance the potential use of alternative crops, reduce soil erosion, reduce the economic, social, and environmental costs of crop pests, and maintain or increase soil biological, chemical and physical properties. New knowledge will reduce disease, wastes and discharges in animal systems while improving husbandry, productivity and food safety.

Research and extension will also look at key areas of various social changes in the marketplace impacting producers, retailers and consumers. The research aims to determine (1) how technology impacts producers/retailers/consumers in the market place; (2) how society impacts consumer demand for

goods and services with a goal of improving the well-being of consumers; and (3) how to develop economic linkages among producers, retailers, and consumers for the community development.

In addition, a broad coalition of agricultural, environmental and food groups has coalesced around the need for integrated efforts for sustainable agriculture and food systems information, research, and education. Outcomes include more economically and ecologically sustainable farms and ranches; a more resilient rural economy; stronger bonds between rural, urban, and periurban residents; and a healthier environment for all Oregonians.

- Conduct Research Experiments
- Conduct surveys
- Conduct Workshops, Meetings
- Deliver Services
- Develop Products, Curriculum, Resources
- Provide Training
- Provide Demonstrations
- Provide Counseling
- Assessments
- Work with Media
- Partnering
- Facilitating

**2. Brief description of the target audience**

- Professional peers and scientific communities, veterinarians, vaccine producers
- State commodity commissions, grower groups, packers, crop consultants
- Natural resource industry clientele - growers, field representatives, grower co-ops and partnerships, processors and handlers, export companies, importing companies
- County, state and federal agencies - USDA-ARS, Oregon Department of Agriculture, Natural Resources Conservation Service, Bureau of Indian Affairs, Confederated Tribes of the Umatilla Indian Reservation, US Forest Service, and Bureau of Land Management.
- Policy makers, public health officials, and community leaders
- Teachers and students, and other educators
- Genetic companies
- Nutritional consultants
- Nonprofit conservation groups and ecologists
- General public and consumers

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

| 2015 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 51060 | 40022 | 4527 | 151950 |

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

**Patent Applications Submitted**

Year: 2015

Actual: 0

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2015 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 63 | 85 | 0 |

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

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Improved and sustainable plant and animal production systems, including precision systems, cultural practices, conservation and population management strategies, innovations, pest control, organic systems, better fertility and reduced uterine infections in dairy and beef cattle and sheep, as well as better understanding of reproductive genetics and developmental biology |
| 2 | Expanded nutrient knowledge in plant and animal systems |
| 3 | Improved plant and animal breeding for improved or novel attributes and for human health benefits, including fertility, health, and productivity |
| 4 | Develop optimum pest management by identifying factors affecting herbicide activity, controlling weeds in organic and no-till production; learning basic pest biology, registering new herbicides or pesticides, finding application rates, and identifying risks associated with a pest as it becomes established |
| 5 | Conduct economic studies to help Producer groups learn about factors shaping global markets and productivity-convergence effects on US agricultural and processed food production and trade |
| 6 | Number of growers (commercial, small and fresh market) that adopt new varietals and methods to reduce yield losses and expenses, rejuvenate orchards, achieve better productivity and efficiency, provide environmental benefits (less fungicide applications, etc.), and effectively compete on the world market |
| 7 | Number that adopt conservation strategies and practices |
| 8 | Number in improved agricultural and fisheries/aquaculture sectors, e.g., commodities |
| 9 | Number of policy makers and other stakeholders that are better informed about plant or animal production methods, technologies, and management techniques |
| 10 | Improved knowledge of consumer and market conditions and factors that affect business survival and competitiveness such as market conditions, process map, business management, types of consumers and their food choices, motivations for food choice, marketing approaches for local markets and community food systems |
| 11 | Improved information about biology, control and resistance of viral, bacterial, fungal diseases, especially disease reproduction, transport and spread; postharvest decay; models to predict risk; and relationships between disease susceptibility and disease resistance |
| 12 | Produce the next generation of growers and agricultural eduactors by integrating agricultural education into high school curriculums and community education |
| 13 | Number whose consumer business knowledge leads to improved opportunities, and more successful starts, activity, survival, and profitability in food enterprises, as well as new and improved value-added products |
| 14 | Study mechanisms of important bacterial diseases affecting food sources in seafood production by enhancing the capacity and sustainability of salmon and trout populations. |
| 15 | Develop targeted intervention strategies to prevent pathogen contamination in bivalve rearing systems. |

| | |
|---|---|
| 16 | To study mechanisms of important bacterial diseases affecting food sources in meat production. |
| 17 | To create diagnostic approaches to characterize the genetic difference between bovine herpesvirus type 1 variants and vaccine strains. |
| 18 | Develop strategies to increase immunity, including the development of vaccines, against pathogens that impact food sources. Identify the role of mother cow immunization on calf protection agains MAP. |
| 19 | Develop new strategies to increase immunity in animals through dietary supplementation of selenium and development of vaccines against influenza. |
| 20 | Evaluate the toxicity of various mycotoxins in food. |
| 21 | Use molecular breeding tools to develop resistance to abiotic and biotic stressors and to improve traits related to human health and nutrition in cultivars of importance in agriculture systems. a) Conduct a systematic evaluation of germplasm resources to identify sources of genetic variation i. Develop new high throughput markers anchored in genome sequences ii. Map genes/QTLs determining target traits iii. Characterize gene/QTL networks and interactions iv. Measure gene/QTL x environment interaction v. Validate and fine map putative genes/QTLs vi. Transfer identified genes/QTLs into economically useful backgrounds, using accelerated generation advance strategies |
| 22 | Improve the nutritional value of important food grains; 2) reduce the impact of wheat storage proteins on human health; and 3) target nutrient development with ripening control. Examples at OSU include barley (Hayes and Ross), wheat (Zemetra, Flowers, and Ross), and grape (Deluc). |
| 23 | The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs. |
| 24 | Fundamental Research Supporting Multiple Breeding Programs. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal). |
| 25 | Evaluation of wheat cultivars for performance and resistance to stripe rust. |

**Outcome #1**

1. **Outcome Measures**

   Improved and sustainable plant and animal production systems, including precision systems, cultural practices, conservation and population management strategies, innovations, pest control, organic systems, better fertility and reduced uterine infections in dairy and beef cattle and sheep, as well as better understanding of reproductive genetics and developmental biology

2. **Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Our overall goal is to provide a comprehensive innovative training in systems biology of animal nutrition, health and well-being to 3 outstanding multicultural graduate students. The theme of the proposed doctoral training program is "training the next generation of scientists for the systems biology era in animal production." The proposed research program will provide novel scientific information through application of holistic (i.e., systems biology) approach to nutritional studies. To achieve these goals, the fellows will be given a vigorous training that entails course work in traditional nutrition, molecular and cell biology, bioinformatics, laboratory rotations, experiential learning, peer-based learning, teaching, internships, externships and outreach. This will equip the NNF fellows to solve challenges associated with efficient animal production, food security, and hunger. Outcome and measurable target of this training include, a) three broadly trained multicultural Ph.D. Fellows, b) peer-reviewed manuscripts and presentations, c) a program for recruitment, retention and graduation of multicultural students, and d) increased placement of multicultural graduate students in academia, industry, and government. Students completing this NNF will: 1) establish an independent research career with a holistic (i.e. systems biology) approach to science, 2) communicate effectively with scientists across disciplines, and 3) translate science-based information to the public and producers. Through this program, we will be able to provide workforce-ready and globally competitive future leaders in TESA of animal agriculture.

**What has been done**
The overall goal is to provide a comprehensive innovative training in systems biology of animal nutrition, health and well-being to graduate students essential in the new ""omics"" era. It is expected that graduate training at the doctoral level can provide technical and functional competencies to conduct multidisciplinary and innovative research, teaching and outreach in agricultural sciences. This will equip NNF fellows in facing challenges associated with efficient animal production, food security, and hunger. Our three objectives are:
Objective 1. Recruit and train three outstanding multicultural Ph.D. students on systems biology applied to animal nutrition, health and well-being.
Objective 2. Mentor three outstanding multicultural Ph.D. students to improve retention and graduation.
Objective 3. Facilitate the transition of three multicultural Ph.D. students from graduate studies to leadership positions in academia, industry, and government.

Outcome and measurable target of this training include, a) three broadly trained multicultural Ph.

D. Fellows, b) peer-reviewed manuscripts and presentations, c) a program for recruitment, retention and graduation of multicultural students, and d) increased placement of multicultural graduate students in academia, industry, and government. Students completing this NNF will: 1) establish an independent research career with a holistic (i.e. systems biology) approach to science, 2) communicate effectively with scientists across disciplines, and 3) translate science-based information to the public and producers. Through this program, we will be able to provide workforce-ready and globally competitive future leaders in TESA of animal agriculture.

**Results**

Objective 1. Recruit and train three outstanding multicultural Ph.D. students on systems biology applied to animal nutrition, health and well-being. - Accomplished.
Objective 2. Mentor three outstanding multicultural Ph.D. students to improve retention and graduation.- in progress.
Three gradaute student started their PhD program in Fall of 2015. The have initiated the research and are also taking the needed gradauate level courses.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 301 | Reproductive Performance of Animals |
| 302 | Nutrient Utilization in Animals |
| 307 | Animal Management Systems |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |

**Outcome #2**

**1. Outcome Measures**

Expanded nutrient knowledge in plant and animal systems

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
With the advancement of the theory of developmental programming it is becoming evident that nutrient intake by the pregnant female can influence progeny performance via epigenetic modifications of gametes and the early embryo in addition to alterations in nutrient partitioning that may augment placental function. Hence, a paradigm shift has occurred with the realization that modifying diets of reproducing females to enhance reproductive or growth performance may indirectly impact performance of their progeny. Our goal is determine how specific nutrients (corn, corn co-products, fats, etc.) impact reproductive processes and their subsequent effects on progeny via developmental programming, to better integrate these discoveries into management strategies in cattle that will enhance whole-system productivity and efficiency.

**What has been done**
Preliminary results from our group demonstrated that protein supplementation positively affects both steer performance and heifer reproductive success. Developmental programming effects have been demonstrated after supplementation during two key periods; 1) early in pregnancy during cell differentiation, and 2) during the third trimester of pregnancy. Additional models will be developed by the group to continue to elucidate key periods during pregnancy when nutrient supplementation may have positive impacts on progeny performance. Specific effects of excess or deficient nutrient status during early or late pregnancy need to be identified. Basic research in this area is a critical step needed to bring developmental programming to the applied producer level.

**Results**
Data generated from the research conducted in experiments proposed herein are related to agricultural processes with the potential to enhance the productivity and quality of livestock in a sustainable manner that will boost U.S. agricultural production and improve global capacity to meet growing food demand, one of five national priority areas identified by the USDA in 2010. In beef cattle, loss of early embryos results in cows failing to conceive during the breeding season or to conceive late in the breeding season. This early embryonic loss costs the U.S. beef industry more than $1 billion annually. In addition, 1.1 kg of weaning weight is lost for each day between the start of calving season and when a calf is born, which translates to a loss of $2.42 per day per calf or almost $17 per week per calf as the calving season progresses, and the profitability of a steer born during the first vs. third 21 days of the calving season is estimated to be $80 greater at weaning and $77 greater at harvest. Our recent data have demonstrated that beef cows exposed to ovulation synchronization and fixed-time AI subsequently have 6% greater weaning rates and increase weaning weights by 17 kg per cow exposed. By improving reproductive management programs to increase the number of cows that utilize ovulation control and AI from approximately 2 million cows to approximately 30 million cows, would result in 476 million kg of increased weaning weights.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 121 | Management of Range Resources |
| 301 | Reproductive Performance of Animals |
| 302 | Nutrient Utilization in Animals |
| 307 | Animal Management Systems |
| 502 | New and Improved Food Products |

603 Market Economics

**Outcome #3**

**1. Outcome Measures**

Improved plant and animal breeding for improved or novel attributes and for human health benefits, including fertility, health, and productivity

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Male farm animals produce semen, which is a bodily fluid containing sperm cells. Sperm cells are self-propelled DNA delivery vehicles. Whereas the biological basis for semen production is well-known, the reasons why semen quality varies among males within a breed are largely unknown. This work uses the chicken as an experimental animal. This is because the self-propulsive nature of chicken sperm has been changed by genetic selection. Consequently, the goal of this research is to identify genes that either minimize or maximize the effectiveness of chicken sperm cells. In other words, this work will not be conducted to find infertile males. Rather, this work will be done to explain why some fertile males are much more fertile than others. Experimental outcomes will have direct relevance to primary breeders of poultry within the United States. The ultimate goal of the research is to enable breeders to select for semen quality in addition to growth rate, egg laying, and disease resistance using information found in DNA.

**What has been done**

The quality of poultry semen can now be defined as the number of mobile sperm produced per male per day. This new quantitative definition stems, in part, from: 1)the PD's discovery of a quantitative trait in the mid-1990s and, 2)prior USDA awards that enabled estimation of heritability as well as an explanation of phenotype at the cellular, organelle, and protein levels. The primary goal of the current work is the discovery of gene networks that determine sperm mobility phenotype. This goal stems from the demonstration that phenotypic variation is due to a genetic predisposition that puts sperm cells at risk of mitochondrial failure as they pass through the excurrent ducts of the testis. In other words, mitochondrial failure stems from a set of conditions that interact to affect sperm in a stochastic manner. Mitochondria are the organelles that enable sperm to be self-propelled DNA delivery vehicles. The mitochondrial failure that renders sperm

immobile occurs in all roosters. However, the extent to which this happens varies among roosters and has genetic basis; for low and high sperm mobility lines have been produced by genetic selection. Birds within these lines will be used to: 1) identify those reproductive tract attributes that interact with a male's genome to affect phenotype, 2)study the role of a candidate gene, 3) compare the sperm cell proteome to the transcriptome of the testis in which those sperm were produced, and 4)explore the genotype x environment interaction by two different and yet complementary means. It is noteworthy that testis transcriptome and sperm cell proteome analyses will include pedigree males from the US primary breeder industry. In summary, this project will have three expected outputs. First, testicular gene expression will be related to differences in semen quality among normal, fertile males. Second, semen production is a critical production trait, and work to be performed will enable semen production to be understood in a systems biology context. Third, loci of interest to be characterized, in particular those on chromosome 6 and the Z chromosome, should enable primary breeders to add a new dimension to their SNPlotyping effort. To date, this means of evaluating the relationship between genomic DNA and key production traits has not included male fertility. In conclusion, this work will help answer a key question in poultry breeding: can DNA be taken from a chick or at hatch and be used to predict -- with some assurance -- fertility at sexual maturation in the case of males and the reproductive potential of male progeny in the case of females.

**Results**
Males within an F2 generation were phenotyped during the review period. The phenotype distribution was distributed normally. The phenotype of roosters from each of the tail's distribution was confirmed by nested ANOVA and DNA from these roosters were used for a GWAS. This analysis confirmed that loci on the Z chromosome were indeed associated with sperm mobility phenotype. In addition, these males were used to demonstrate the importance of sperm mobility phenotype within the context of artificial sperm storage.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 301 | Reproductive Performance of Animals |
| 307 | Animal Management Systems |
| 502 | New and Improved Food Products |

**Outcome #4**

**1. Outcome Measures**

Develop optimum pest management by identifying factors affecting herbicide activity, controlling weeds in organic and no-till production; learning basic pest biology, registering new herbicides or pesticides, finding application rates, and identifying risks associated with a pest as it becomes established

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Situation: The use of pesticides has come under much scrutiny and review in recent years. The negative attention directed towards the use of pesticides has had a strong impact on turfgrass management, which relies on the use of herbicides to control weeds in established turfgrass stands. The use of pesticides, such as diazinon (organophosphate) and Dursban (chlorpyrifos), and herbicides, such as clopyralid, has been limited and in some cases banned by the Environmental Protection Agency (EPA). Countries, like Denmark and Canada as well as states, counties and cities in the United States have even gone as far as to phase out the use of herbicides on municipal turfgrass and public property. Considering these increasing bans and restrictions the demand for herbicide alternative weed control methods is great.
In 2003, collaborative research between Oregon State University and the United States Department of Agriculture first determined that bacteria-free culture filtrates of P. fluorescens isolates WH6 and E34 irreversibly arrest the germination of seeds of P. annua immediately following emergence. Research concluded that these isolates produced and secreted a putative Germination-Arrest Factor (GAF). The GAF activity from both isolates arrested the germination of several species of graminacious weeds and crop plants, including Aegilops cylindrica (jointed goatgrass), Bromus tectorum (Downey brome or cheat grass), Vulpia myuros (rattail fescue), six perennial and annual species of Poa, as well as tall fescue (Festuca arundinacea) and perennial ryegrass (Lolium perenne). These laboratory findings present strong evidence for the further development of P. fluorescens WH6 and E34 as a pre-emergence bio-control agent.

**What has been done**

Approach: Research in collaboration with the USADA ? Forage Seed and Cereal Research Unit evaluating the pre-emergence effects of P. fluorescens WH6 on annual bluegrass in an established perennial ryegrass stand was initiated on March 11, 2013 at the Lewis-Brown Horticulture Farm, Corvallis, OR. Pseudomonas applications were made twice annually (spring and fall) at varying rates on a perennial ryegrass stand in March and again in October. Prior to fall Pseudomonas applications P. annua seed was applied to the plots. Poa annua germination rates, as well as perennial ryegrass health and vigor was assessed throughout the year. In 2014, the methodology defined above was repeated.

**Results**

Outcomes and impact: Findings from this research would provide the turfgrass industry stakeholders, as well as the majority of horticulture related industries (i.e. gardens, landscape areas, nursery field plantings, vegetable crops, vineyards and orchards), with a naturally derived pre-emergence weed control method of P. annua, which is considered one of the most problematic turfgrass weeds in the Pacific Northwest and Midwestern U.S., as well as Canada. Commercial application of a viable bio-control agent such as this would be particularly

advantageous in areas with increasing pesticide bans and restrictions, such as Canada, Washington, Oregon and California. When the Oregon grass seed industry is taken into consideration and the current need for P. annua control methods due the phase out of field burning, the utilization of this pesticide alternative weed control method could be immense

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 601 | Economics of Agricultural Production and Farm Management |
| 603 | Market Economics |

**Outcome #5**

**1. Outcome Measures**

Conduct economic studies to help Producer groups learn about factors shaping global markets and productivity-convergence effects on US agricultural and processed food production and trade

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Conventional and organic farmers utilizing organic waste products and cover crops as fertilizers only had access to general published estimates of N mineralization. Organic fertilizers are also expensive and contain different nutrient ratios. This made it difficult for farmers to match organic fertilizer rates with soil requirements and identify the most cost-effective fertilizer program. Total N content and plant-available N (PAN) content of cover crops is difficult to estimate in the field. Growers also lacked tools to compare the cost of cover cropping to the cost of fertilizers when

developing nutrient management plans. In collaboration with Dan Sullivan (Department of Crop and Soil Science) I am developing methods and tools for growers to estimate PAN from cover crops and organic fertilizers and to identify balanced and cost effective nutrient management plans.

**What has been done**

Most recently a UI Soil Scientist secured funding to develop a similar N mineralization calculator for cover crops in Idaho, and a team In 2012 NRCS and Oregon Tilth were awarded a WSARE PDP grant to teach conservationists in the PNW to use the OSU calculator. With funding from this grant, Andrews and Sullivan have been teaching nutrient management workshops for agricultural professionals in California, Oregon, Washington. In 2008 we developed and launched the OSU Organic Fertilizer Calculator. It allowed growers to determine the most cost effective and balanced fertilizer program for all nutrients and integrated an existing PAN model for organic fertilizers (Sullivan). With grant funding from WSARE, we compared field methods for estimating total N content of cover crops. I also proved the concept that total N analysis of a sample with a mixture of cover crop species could be used to estimate cover crop PAN. With funding from an OSU Special Grant, Sullivan and I validated a published PAN model for crop residues with laboratory and field trials. Jim Julian (OSU Agricultural and Resource Economics Department) and I developed an economic spreadsheet to estimate the cost of using cover crops. The cover crop PAN model and economic spreadsheet were combined with the original fertilizer calculator to develop the OSU Organic Fertilizer and Cover Crop Calculator. The website also includes cover crop field sampling instructions. In 2014 a modified version of the calculator was developed for small farms and gardens.

**Results**

The original Organic Fertilizer Calculator was launched in 2008 and extended to cover crops in 2010. From 2008-2010 it had over 1600 registered users. From 2010-2013 more than 840 people from 47 countries have registered to use the expanded Organic Fertilizer and Cover Crop Calculator. More than 540 were in the U.S. with Oregon (149), Washington (83) and California (49) having the most registered users. Over 160,000 acres are managed by people registered to use the calculator. If 25% of the registered users save $50/acre/year on reduced fertilizer costs or increased yields, the estimated annual economic impact of the new calculator is more than $2 million. Most registrants identified themselves as farmers (291 or 36%) or other agricultural professionals (318 or 39%). 137 students (17%) and 60 gardeners (7%) also registered. At the end of 2010, 19 agricultural professionals responded to an online user survey. The main users were Extension faculty and conservation planners. They rated the overall helpfulness of the calculator at 4.4/5. 8 use it in their teaching, 11 in their extension work and 7 in their research.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 111 | Conservation and Efficient Use of Water |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |

603 Market Economics

**Outcome #6**

**1. Outcome Measures**

Number of growers (commercial, small and fresh market) that adopt new varietals and methods to reduce yield losses and expenses, rejuvenate orchards, achieve better productivity and efficiency, provide environmental benefits (less fungicide applications, etc.), and effectively compete on the world market

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Situation: Vine balance is a central dogma of viticulture production that links vine production principles to vine physiology. However, it is not easily defined and often metrics used to identify "balance" is a moving scale for each growing region. Industry members currently do not use a vine balance approach to govern management practices. Oregon vineyard and wineries operations significantly reduce vine yields by crop thinning 20-50% of their crop each year to achieve low yield targets. This has become a parameter of fruit quality that is demanded by wineries in Oregon, but has not been validated through a systematic scientific approach. Crop thinning is a practice that is conducted manually, and it is the most expensive management practice in vineyard production ($540/acre, 40 hours/acre). In Oregon"s climatic conditions, vines are highly vigorous and require hours of labor to hedge and remove leaves ($360/acre) to open up the canopy. The conventional wisdom behind low target yields is that low yielding vines have superior grape quality. However, naturally low yielding vines are small in size and have different physiology than most moderate to highly vigorous grapevines in Oregon. Low yields in Oregon are achieved in the vineyard through heavy canopy manipulation and cluster thinning, which I refer to as "vineyard liposuction." Industry members, largely grape growers and vineyard managers, are frustrated with current yield restrictions and are unsure what yields they should be targeting for long-term vine health, a balanced vine canopy and good fruit quality. These concerns have been voiced in industry technical groups as well as through an industry survey and interviews conducted in 2012 and 2014. A publication outlining the results of the surveys and interviews was accepted by the Journal of Extension (JOE) in September 2015 and awaits publication in 2016.

**What has been done**

Funding was obtained to conduct research on vine balance since 2010. Multiple projects have been conducted to evaluate canopy management practices (such as leaf removal or lateral removal) and yield management (cluster thinning) in a combination of conditions, including different levels of vine vigor and timing/intensity of yield management practices. This work has been conducted within more than 15 vineyards and across more than six American Viticultural Areas (AVAs) in the state of Oregon. These data are being used in long-term research to determine better metrics for vine balance and quality for Oregon's grape-growing regions. Several research projects have been designed and funded from 2010 onward:

Project 1: Determining the effect of timing and intensity of cluster thinning on vine growth, vine nutrition, and fruit composition of Pinot noir in the Willamette Valley and Southern Oregon (2010-2013)

Project 2: Determining the level of cluster zone leaf removal needed for enhanced Pinot noir fruit quality (2010-2012)

Project 4: Statewide Crop Load Project: An industry collaborative long-term project to understand vine balance metrics for Quality Pinot Noir (2012 to Present)

Project 5: Determining vine nutrient guidelines for vine growth and fruit quality of Oregon Pinot noir (2010-2014)

Project 6: Impact of vine vigor and cropping level on Pinot noir vine physiology, vine nutrition, fruit composition and wine sensory (2011-2013)

Project 7: Impact of vine vigor, carbohydrates and nitrogen on bud fruitfulness and vine productivity of Pinot noir (2014-2016)

Project 8: Determining the impact of lateral shoot removal and leaf removal on bud fruitfulness (2014-2016)

**Results**

We have been successful in obtaining funding for projects of high priority for industry as they address vineyard sustainability, economics, and fruit quality. The projects listed above were developed over time and have built upon each other as new research findings were realized. Results of numerous projects indicated that there is not a clearly defined crop level that leads to earlier ripening or increased fruit quality. In conducting this work in other regions of the state, we found that greater yields are attained in other regions with improved quality. We are trying to fine-tune the yield-canopy relationship of vine balance and identify the best fruit yields based on vine health, sustainable growth responses, and premium fruit production on an annual basis. The research will save growers thousands of dollars per acre on vineyard expansion ($25,000/acre to establish a vineyard) to meet winery growth. Secondly, our augmented canopy management methods increase fruit quality and reduce labor inputs. Finally, reduced canopy management costs will provide an additional savings of $300-900/acre annually. The preliminary data of these studies was made available to the industry through numerous seminars, several newsletter articles, annual industry technical group meetings, and various invited seminar presentations from 2011 through 2015.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |

| | |
|---|---|
| 216 | Integrated Pest Management Systems |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |

**Outcome #7**

**1. Outcome Measures**

Number that adopt conservation strategies and practices

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Changes in demographics and economics in the Mid-Columbia region of Oregon and Washington have resulted in an increased demand for Extension programs for small producers and
alternative agricultural enterprises. Most of these small farmers and landowners have little or no experience with agricultural production, pesticides, soil and water conservation practices, marketing and/or economics.

**What has been done**
In the fall of 2000, I organized a meeting with OSU and WSU Extension Agents from the four Mid-Columbia counties. At this meeting we determined that a cooperative regional effort combining the available technical and financial resources would provide a more efficient and effective response to this increased demand. This was the beginning of the Mid-Columbia Small Farms and Acreage program.
Since the inception of this program, we have established the bi-monthly Mid-Columbia Small Farms and Acreage Newsletter (I serve as editor), which is distributed both electronically and as a paper copy to over 1000 area small farmers and agency staff in a twelve-county area of the Columbia Basin of Oregon and Washington, created the Mid-Columbia Small Farms web site that hosts the Small Farms and Acreage Newsletter and serves as a library of technical articles,

newsletters, and other resources for small farmers and public and private agencies and developed numerous technical articles for use by area small farmers and landowners. We have also produced numerous regional educational programs offered including the Farm and Ranch Survival Kit and Farms Succession Programs. We were able to secure a number of USDA SARE and RME grants for over $400,000 that were used to support educational program development in the region and made eight state, regional and national conference oral and poster presentations about the development of our Mid-Columbia Small Farms program.

**Results**

Peer validation for our Mid-Columbia Small Farms and Acreage Program has been demonstrated through NACAA State and National Awards. The newsletter initially was distributed to a four county area in the Mid-Columbia, but due to requests has expanded to a twelve county area along the Columbia Basin of Oregon and Washington, and further expansion into additional counties in the coming months. Our small farms web site is frequently used and currently receives nearly 2000 hits per month.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 102 | Soil, Plant, Water, Nutrient Relationships |
| 111 | Conservation and Efficient Use of Water |
| 121 | Management of Range Resources |
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 301 | Reproductive Performance of Animals |
| 302 | Nutrient Utilization in Animals |
| 307 | Animal Management Systems |
| 311 | Animal Diseases |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |
| 903 | Communication, Education, and Information Delivery |

**Outcome #8**

**1. Outcome Measures**

Number in improved agricultural and fisheries/aquaculture sectors, e.g., commodities

Not Reporting on this Outcome Measure

**Outcome #9**

**1. Outcome Measures**

Number of policy makers and other stakeholders that are better informed about plant or animal production methods, technologies, and management techniques

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
With an annual acreage of approximately 17,000 acres, red clover seed is one of the most important legume crops in Oregon seed production. Given a recent reduction in contracted grass seed acreage, many growers have looked to alternatives including increased wheat, vegetable seed, and legume seed production. This trend paired with an increased global demand for utilization of clover in pasture and cover crop systems, has led to an increase in clover acres of 31% in western Oregon between 2007 and 2013. Most of the clover acreage is located in the North Willamette Valley, which has allowed me to take a leadership role in clover seed research at OSU.

As fuel prices increase so too does the price of nitrogen fertilizer. Crimson clover, grown for seed in Oregon, fixes nitrogen at an estimated rate of 50-150 pounds of N per acre while sustaining yield. Research suggests nitrogen from plant sources is more stable and less vulnerable to leaching into water sources than that from manufactured fertilizer. More than 95% of crimson clover seed in the United States is produced in Washington and Yamhill counties. This common cover crop fixes nitrogen and is now being promoted nationally for its functionality. Crimson clover sales from Oregon in 2012 totaled about $2.5M, but the sustainable character of the market

suggests that this value can be increased.

**What has been done**
Faculty worked closely with the Oregon Clover commission to develop and implement an educational program plan. As part of this plan, efforts included: 1) authoring a 3-fold educational brochure title "Crimson Clover as a Cover Crop"; 2) developing content for the "Cover Crop" section of the new Oregon Clover website http://www.oregonclover.org/uses/covercrop/, administered by the Oregon Clover Commission; and 3) traveling to three states (Indiana, Illinois, Kentucky) to participate in organized meetings with local agronomists and growers in the Midwestern U.S. to investigate opportunities for Oregon clover seed growers to produce a quality seed product that is desired by cover crop producers. After each trip, faculty provided a report to the Oregon Clover Commission summarizing input that had been provided by the Midwestern end-users.

**Results**
The initial printing of 5,000 brochure copies was exhausted in early 2012. A second printing of 10,000 copies has occurred and several thousand more copies have been distributed to 15+ seed companies, 8 NRCS offices, and 5 large-scale custom seed applicators, all of whom operate out of the midwestern and southeastern United States and requested brochures to help educate their clientele. Since its establishment in the fall of 2011, approximately 180 different users accessed information from the "Cover Crop" section of the Oregon Clover website. The average time spent on the page was 4 minutes and over 60% of the users directly searched and landed on the cover crop page.
As a result of interactions in the cover crop production region, the Oregon Clover Commission has: a) funded research with a clover plant breeder in Indiana who is selecting for cold-hardy crimson clover lines, b) hired two cover crop consultants based in the Midwest to work further developing sound recommendations for using clovers as a cover crop, and c) invited clover cover crop producers and researchers to Oregon and gave presentations that have helped educate Oregon clover seed growers about the end-user quality components that are needed to increase adoption of clover as a cover crop.

Record crimson clover seed movement from Oregon to Midwest markets has occurred over the last several years. This is new market movement that has not been experienced in the past. As a result, prices paid to Oregon growers have increased from $0.35 to $1.25/lb in 4 years. This represents $4.7 million in increased earnings for Oregon crimson clover seed producers.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 205 | Plant Management Systems |
| 216 | Integrated Pest Management Systems |
| 307 | Animal Management Systems |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |

## Outcome #10

### 1. Outcome Measures

Improved knowledge of consumer and market conditions and factors that affect business survival and competitiveness such as market conditions, process map, business management, types of consumers and their food choices, motivations for food choice, marketing approaches for local markets and community food systems

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
A less examined facet of the local foods movement is the impact of the location of the producer on the feasibility of operating as a local supplier. Obvious variables are labor hours in travel to regional markets and fuel expenditures. The costs these engender is strongly related to the density of customers that are willing or able to deal with smaller scale delivery. Whether supplying produce or a value-added food, the viability of an enterprise which hopes to diversify its markets or products through a local channel is dependent on that density. Furthermore the price received varies greatly depending on whether the customer is a farmers market consumer, a local grocer or restaurant, or-as those markets are exhausted-a distributor. With value-added products (28% of farms engaged in entrepreneurial activities are producing value?added products (Martinez 2010)) the availability of alternative channels and pricing received in them is particularly important due to the capital investment required for equipment.

**What has been done**
Data on fixed and variable costs for cheese production and business start-up for the model was collected in an in-depth survey of six operating artisan cheese firms. Supplemented with current information on equipment costs, retail space rental, and labor costs from business and governmental sources, a business model was designed within Microsoft Excel 2010 that effectively describes the business environment in which an artisan cheese company might exist. The model estimates size of the production and aging facilities and capital cost based on intended production volume and cheese types produced. Economic feasibility is measured through net present value (NPV) and Internal Rate of Return (IRR) of the investment, breakeven analysis is also included in the spreadsheet model utilizing Microsoft Excel Solver. To examine scenarios data is entered into the USER INPUT SHEET.

Among other variables, the tool allows the number of farmer?s markets, the local grocers and restaurants within practical reach, and the average distance to these to be entered. To examine the impact of location on feasibility four scenarios (rural, semi-rural, sub-urban, urban) with respect to these market variables were designated and NPV for each examined across four final (post-startup) production volumes (7500, 15000, 30000, and 60000 pounds produced annually). To account for land cost differences, these scenarios assume processing facilities are rented and appropriate rental cost is used.

**Results**
The viability of an artisan cheese business is profoundly impacted by the location selected. Sensitivity analysis was undertaken across key revenue and cost variables, the most important being milk price, cheese style, product retail price, and geographical location of the creamery. Other variables examined include fuel cost, labor cost, distance to farmers markets, distance to wholesalers, cheese yield and aging time, processing days per year. Location produced a greater range in NPV than 25% swings in any of the other model variables except retail price.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |

**Outcome #11**

**1. Outcome Measures**

Improved information about biology, control and resistance of viral, bacterial, fungal diseases, especially disease reproduction, transport and spread; postharvest decay; models to predict risk; and relationships between disease susceptibility and disease resistance

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

New industrial processes have enabled the development of pesticide nanoformulations that are active longer against pests than the same active ingredient with a conventional formulation. These processes include creating tiny pesticide particles, which have an outer layer designed to protect the pesticide from environmental breakdown and make it easier to mix with water. The properties of the nanolayer may increase the ability of the pesticide to control pests, and there are many of these new pesticide formations already on the market. However, pesticide particles and dusts are already known to be collected by bees, build up in the pollen they collect, and pose a risk to their colonies. Additionally, making pesticides more soluble in water could possibly affect their ability to move into lakes and streams. Our goal is to research whether nanoformulated pesticides stick to bees more than conventional pesticides, and whether they are more toxic, or toxic longer. We will also examine the toxicity of nanoformulated pesticides to zebrafish in the laboratory. To understand whether nanoformulated pesticide particles can move through the environment differently than conventional pesticides, we will investigate whether bees carry more into their colonies with pollen, and how they may accumulate in and affect plants, insects, and fish in aquatic microcosms, which are aquatic communities we can observe in the laboratory. These data will help us understand whether nanoformulated pesticides behave differently in the environment, and whether we should be more concerned about their potential effects on vulnerable organisms than conventional pesticide formulations.

**What has been done**

We have begun measuring multiple parameters of a selection of 12 pesticide formulations including insecticides, fungicides, and herbicides. Using Scanning Electron Microscopy and hydrodynamic diameter, we have found an astonishing range of particle sizes, beginning as small as 20 nm and approaching 10 mm. Particles shapes vary widely and may be spherical, rod"shaped, irregular flakes, or other shapes. They may agglomerate without considerable dilution. Formulations may be extremely homogeneous, or a complex mix of particulates that vary in size, shape and composition.

**Results**

To investigate whether NBP particles can transfer from foliage to bees, we applied the NBP products to hazelnut leaves. We used these leaves due to the availability of an untreated hazelnut orchard at OSU's Lewis Brown Horticulture Farm, which provided a consistent source of pesticide-free leaves with large surface area. We placed these leaves in a large petri dish, together within honey bees. After 24 hours, we prepared both leaves and bees for examination by SEM. Rovral, has little apparent potential to transfer from foliage to bees. This is interesting, given that we and others find the active ingredient in large concentrations in bee-collected almond pollen, and has been found to impact colony development in our studies. In contrast, we found that Beleaf particles can transfer from leaf to bee. The Sagili lab has analyzed bees, pollen, and other bee hive matrices during carrot pollination, and found that the active ingredient of Beleaf, flonicamid, transfers from carrot plants to honey bee colony, and negative effects on bee development are associated with this exposure. In the case of Rovral, it is possible that the particles adhere to pollen, which is brought into the colony, while Beleaf may transfer directly to bees. These findings indicate that better understanding of NBPs may help reveal important properties that contribute to bee and colony exposure and toxicity.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |

216 Integrated Pest Management Systems

**Outcome #12**

**1. Outcome Measures**

Produce the next generation of growers and agricultural eduactors by integrating agricultural education into high school curriculums and community education

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
The Oregon AITC Foundation provides curriculum, resources and training to K-12 teachers. The program promotes using agriculture to teach science, math, history and nutrition across existing curriculum. AITC?s resources are standards-based and use an integrated, hands-on approach to learning.

**What has been done**
AITC impacted more than 120,000 students across the state during the last school year. AITC works with public, private and home school teachers, as well as after school programs. It maintains an extensive website with a Free Loan Library, and free hands-on lessons and activities available to all Oregon educators.

**Results**
Oregon Agriculture in the Classroom Foundation reached 120,000 students during the last school year. We have just over 2,000 teachers on our mailing list and are working with educators in all 36 Oregon counties. We have one full time and two part-time staff with a college student intern.

We continue to distribute Get Oregonized textbooks. Get Oregonized is a history book written for students in grades three, four and five studying Oregon's history and regions. The text is designed to help students understand and appreciate the rich history, people and natural resources that shaped the state of Oregon. Maps, illustrations and photographs complement the easy to read text.This was updated in 2013, this last year over 1,000 copies were distributed to Oregon schools.

We reached more than 18,000 students through our seventh annual literacy project featuring The

Tree Farmer. Over 600 trained volunteers read to K-5 students in 32 of our 36 counties. Volunteers spent about 45 minutes in each classroom and shared their personal connection to agriculture with teachers and students.

Over 300 people attended our Fall Harvest Dinner, which is our only fundraising event. We raised $42,000 and sold 42 cases of Get Oregonized books that will be donated to schools throughout the state.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 903 | Communication, Education, and Information Delivery |

**Outcome #13**

**1. Outcome Measures**

Number whose consumer business knowledge leads to improved opportunities, and more successful starts, activity, survival, and profitability in food enterprises, as well as new and improved value-added products

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

Increased consumer interest in grass-fed, naturally raised, locally produced meats is based on perceptions and evidence about ?healthier? fats, reduced environmental impacts, and increased animal welfare associated with meats not raised in confinement systems on grain-based diets (Daley et al. 2010; National Trust 2012; Schmidt 2010; Umberger et al. 2009; Varnold et al. 2011); this interest is also part of the broader local food movement (Martinez et al. 2010). Live- stock producers who would like to produce and sell grass-fed meats must carefully weigh the risks of shifting their production and marketing systems, given the significant and often costly supply chain challenges of getting this type of meat to market. Knowing, in general, that consumer demand for grass-fed is ?up? is not enough: producers require geographically relevant information not only about consumer demand and price elasticity, but also how and where consumers will buy the product (such as by the cut or by the carcass,

direct or at a store, at main-stream or natural food retailers).

**What has been done**

Our study provides several new insights into the market for grass-fed beef. First, we examine consumer interest in buying grass-fed beef in bulk, a valuable and potentially necessary strategy for direct sales by producers. Second, we expand understanding of WTP for grass-fed beef relative to conventional beef by exploring the effect of consumers? prior knowledge and uncovering the underlying consumer attitudes that result in WTP a premium for grass-fed beef. Finally, we expand understanding of the impact of taste preference on WTP by incorporating consumer ratings of the beef they tasted directly into the choice model.

**Results**

Our study of consumer preferences and WTP for grass-fed beef has four primary findings. First, our WTP results for grass-fed beef are within the bounds of those found elsewhere in the country, when compared only with more current studies. We suggest recent WTP estimates are higher than older studies due to an increase in general consumer knowledge about grass-fed over the years. Second, if participants in this study are representative of the Portland Metro region, there is significant interest in the region in buying beef in bulk, i.e., sacrificing some convenience to purchase grass-fed beef. Third, we confirm other research findings that whether a consumer typically shops at natural food stores or mainstream stores does not matter to WTP or willingness to buy in bulk. Fourth, we find that knowledge about production and nutritional qualities, and also attitudinal variables, are what matter instead. For example, the premium consumers are WTP for grass-fed beef increases when consumers know something about possible health benefits associated with it. When knowledge and attitudinal variables are known and included in the model, the effect of shopping location drops away.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |

**Outcome #14**

**1. Outcome Measures**

Study mechanisms of important bacterial diseases affecting food sources in seafood production by enhancing the capacity and sustainability of salmon and trout populations.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Researchers have continued to work with the Prespawning Mortality (PSM) in Chinook salmon. team, where he leads pathological investigations. As in the previous 6 years,we evaluated the prevalence and abundance of pathogens, and associated lesions in about several hundred adult salmon collected from the Willamette System in 2015. They are investigating correlations with pathogens, histological changes, temporal progression of diseases through the summer before spawning, and climate and hydrological parameters. The ultimate goal of the project is to determining factors influencing PSM and to develop strategies that fisheries managers can use to reduce PSM.

**What has been done**
In the last year, we published 2 papers (one additional in review near acceptance) comparing infection patterns with various endpoints. Major contribution with all three studies was providing diagnosis/identification of pathogens. In Benda et al. (2015), we document that capturing returning salmon early in their run in the Willamette River, and holding them in cool, pathogen free water at OSU dramatically reduces pathogen burdens and increases survival to spawning. Other researchers lead a study comparing immunological endpoints with time over summer before spawning (Dolan et al. 2016). Finally, a post-doctoral fellow in our team, lead a project evaluating sensitivity and specificity of histology identification for the most common pathogens found in these salmon (Colvin et al. 2015).

**Results**
We demonstrated that while pathogens increase over time in the salmon in the Willamette River before spawning, that they are not connected specifically with immunosuppression. This study also showed that the adaptive immune response remains intact until spawning and death shortly thereafter in the fall, but that innate immunity wanes as the summer progresses before spawning. Our team also developed an occupancy model for improving accuracy of diagnosis using relatively insensitive diagnostic tests, such as histology. This model has ramifications beyond diagnostics for salmon diseases as the study provided a formal approach to utilize diagnostic tests with varying sensitivity to analyze pathogen detection data and to avoid negative biases due to imperfect detections, as is common when using histology a survey test.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 301 | Reproductive Performance of Animals |
| 307 | Animal Management Systems |
| 311 | Animal Diseases |

| | |
|---|---|
| 502 | New and Improved Food Products |
| 903 | Communication, Education, and Information Delivery |

**Outcome #15**

**1. Outcome Measures**

Develop targeted intervention strategies to prevent pathogen contamination in bivalve rearing systems.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Previous work in the Häse laboratory has led to the development of a sensitive, specific lateral flow immunoassay (dipstick assay) that is sensitive for the detection of Vibrio tubiashii zinc metalloprotease (VtpA). However, previous confusion about the identity of some presumptive V. tubiashii strains led to the conclusion that V. tubiashii was a significant pathogen in Pacific Coast hatcheries. Recent evidence revealed that some of the strains previously identified as V. tubiashii were actually V. coralliilyticus and we found that V. coralliilyticus is more pathogenic than V. tubiashii in Pacific oyster larvae, suggesting that V. coralliilyticus is a more substantial pathogen than V. tubiashii and that V. coralliilyticus may have been problematic in Pacific hatcheries for many years. Importantly, our "pet strain" RE22, which we used to create the monoclonal antibodies used in our dipstick detection assay is a V. coralliilyticus rather then V. tubiashii. We therefore re-named the zinc-metalloprotease that is detected in the dipsticks VcpA.

**What has been done**
Using funding from the AES grant "Diseases of Animals as Important Inhibitors of Food Security", we have further improved the detection capacity of this dipstick. In collaboration with Dr. Mike Marusich, mAbDx, Inc. (located in Eugene, OR), we further enhanced the consistence as well as sensitivity of the dipsticks by using a Nano-Dispenser, available to our collaborator at the Abcam Inc., location in Eugene. We have successfully transitioned our basic prototype device into a completely self-contained, self-developing and highly sensitive diagnostic test. The test, now named the "Vibriosis RapidTest" is now a true diagnostic Lateral Flow Assay (LFA) that is robust (rugged, durable and reliable), extremely easy to use (simply add a sample of unprocessed

seawater), and highly sensitive. The performance of each critical kit component was assessed and then modified and optimized as needed through a series of 4 iterative ?generations? of the device.

**Results**
Application and immobilization of immunocapture reagents in the "Test?" line and "Control" line zones was improved and standardized to improve both the sensitivity and reproducibility of the assay. The prototype tests were produced by manually applying spots of capture reagents in approximate zones on partially completed dipsticks. We now use high quality robotics to apply the immunocapture reagents precisely in defined linear zones on large production cards and then use an automated cutting mechanism to cut and process the cards into individual dipsticks. The individual dipsticks are then inserted and sealed in durable plastic cassettes that have a sample port and a visual readout window over the appropriate zones on each dipstick.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 307 | Animal Management Systems |
| 311 | Animal Diseases |
| 502 | New and Improved Food Products |
| 603 | Market Economics |

**Outcome #16**

**1. Outcome Measures**

To study mechanisms of important bacterial diseases affecting food sources in meat production.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Bovine respiratory disease (BRD) is the most common and costly disease of feedlot cattle in the US. Preconditioning programs that include vaccination for viral and bacterial agents that cause BRD are one of the most effective management methods that mitigate the incidence of this

disease. In typical western US beef operations that adopt preconditioning programs, calves receive vaccination against BRD pathogens at weaning and are revaccinated 30 days later at feedlot entry. However, weaning and feedlot entry are two of the most stressful situations encountered by feeder cattle, and vaccine efficacy can be reduced if administered to highly-stressed animals. In addition, vaccination against BRD pathogens elicits innate immune responses known that impair cattle performance, particularly during feedlot receiving. Therefore, altering the time of vaccination/revaccination against BRD pathogens is a strategy that has been recently, but partially, investigated. Research conducted to date focused on delaying the time of vaccination by 2 weeks following a stressful situation, and indicated that delaying vaccination increased performance and seroconversion to a BRD pathogen in feedlot cattle. However, the majority of BRD cases occur within the first 14 days upon feedlot arrival, and delaying revaccination by 2 weeks may not provide full immunological protection against BRD pathogens to newly-received feeder calves. Based on this rationale, we hypothesized that anticipating vaccination and revaccination against BRD pathogens by 2 weeks is a strategy to further enhance vaccine efficacy, health variables, and performance traits of in feeder cattle. One example is providing the initial vaccination 15 days prior to weaning, and revaccination 15 days prior to shipping to the feedlot within a 30-day preconditioning program. This strategy would allow for vaccine administration during periods of minimal tress, ensure that cattle receive both doses and are better protected against BRD prior to feedlot entry, and eliminate the performance losses caused by vaccination during feedlot receiving. Therefore, the goal of the proposed research is compare the effects of anticipated (15 days prior), delayed (15 days after), or vaccination at the time of weaning and feedlot entry on vaccine efficacy, health, and performance variables of feeder cattle.

**What has been done**
108 calves will be vaccinated according to experimental design at 7 months of age and revaccinated at feedlot entry.

**Results**
This research has just begun and initial results will be reported during the next reporting period.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 307 | Animal Management Systems |
| 311 | Animal Diseases |
| 502 | New and Improved Food Products |
| 903 | Communication, Education, and Information Delivery |

**Outcome #17**

**1. Outcome Measures**

To create diagnostic approaches to characterize the genetic difference between bovine herpesvirus type 1 variants and vaccine strains.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
In summary, a streamlined workflow includes an innovative automated dsRNA denaturation during nucleic acid purification, followed by the simultaneous detection of BTV and EHDV by mRT-qPCR. This workflow provides rapid, reliable results, and reduces the potential for contamination and human error by eliminating the separate denaturation step commonly used to denature BTV and EHDV dsRNA. Implementation of this workflow will enable detection of single and dual infections in diverse samples for regulatory testing, herd health management, and differential disease diagnosis. The simultaneous and differential detection of BTV and EHDV provides significant benefits for two important ruminant diseases with similar clinical presentations, particularly in light of reports of BTV- and EHDV-associated clinical disease in cattle.

**What has been done**
Bluetongue virus and EHDV infections can have a negative economic impact on the sheep, cattle and deer industry. Identification of these viruses is important in order to evaluate their distribution and epidemiology. Our objective in this proposal is to validate a new innovative workflow method developed by our collaborator at Texas A&M for the differential detection of BTV and EHDV in clinical samples. Implementation of the workflow in routine diagnostic testing enables the detection of, and differentiation between, BTV and EHDV, and coinfections in bovine blood and cervine tissues, offering significant benefits in terms of differential disease diagnosis, herd health monitoring, and regulated testing.

**Results**
We expect to validate a new innovative workflow method developed by our collaborator at Texas A&M for the differential detection of BTV and EHDV in clinical samples. This improved method includes automated dsRNA denaturation during nucleic acid purification, followed by the simultaneous detection of BTV and EHDV by mRT-qPCR. After the validation of our tests in the clinical samples, we will provide diagnostic service to clients from Oregon and other states. The BTV and EHDV tests will greatly benefit clients from sheep, goat, cattle, and wildlife Industry by providing more options for rapid, accurate and affordable testing.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|

| | |
|---|---|
| 307 | Animal Management Systems |
| 311 | Animal Diseases |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 903 | Communication, Education, and Information Delivery |

**Outcome #18**

**1. Outcome Measures**

Develop strategies to increase immunity, including the development of vaccines, against pathogens that impact food sources. Identify the role of mother cow immunization on calf protection agains MAP.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Bovine herpesvirus 1 (BoHV-1) is a virus of the family Herpesviridae and the subfamily Alphaherpesvirinae, known to cause several diseases worldwide in cattle, including rhinotracheitis, vaginitis, balanoposthitis, abortion, conjunctivitis, and enteritis. BoHV-1 is also a contributing factor in shipping fever, also known as bovine respiratory disease (BRD). It is spread horizontally through sexual contact, artificial insemination, and aerosol transmission and it may also be transmitted vertically across the placenta. BoHV-1 can cause both clinical and subclinical infections, depending on the virulence of the strain. Although these symptoms are mainly non-life-threatening it is an economically important disease as infection may cause a drop in production and affect trade restrictions.

**What has been done**
Although modified-live multivalent vaccines, such as PregGuard GOLD and Bovi-Shield Gold, have been used routinely in both beef and dairy cattle in the US, abortion and respiratory diseases still occasionally occur following vaccination. To determine whether the antibody induced by the multivalent vaccine can recognize BHV-1 isolates from aborted animals, BHV-1 antibody titer was evaluated with two isolates from abortion cases and two vaccine BHV-1 viruses. Cattle serum was collected from a dairy herd that was vaccinated annually with Bovi-

Shield Gold 5 vaccine.

**Results**

Among the 28 cattle tested, no statistical significant difference in serum neutralization titer was observed when test virus was either vaccine virus or clinical isolates. It suggests that the BHV-1 antibody from the vaccinated cattle can recognize both the vaccine virus and clinical isolates. However, it is noticed that cows at 5 years old or older had a significantly lower BHV-1 antibody titer on average than the average of SN titer in 3 year-old cows. Similarly, cows at 5 years or older had a significantly lower BVDV antibody titer than cows at about 2 years of age. In addition, cattle vaccinated within 0-2 months had a significantly higher BHV-1 titer than those that received vaccination 6 months or greater prior to titer measurement. In contrast, cattle that received a vaccination 6 months prior had a significantly higher anti-BVDV antibody titer than those vaccinated within 1-2 months. The BVDV antibody titers remained relatively unchanged between 6 months and 1 year post-vaccination. Our study suggests little antigenic variation exists between BHV-1 disease isolates and BHV-1 of the multivalent vaccines. In addition, BHV-1 antibody titer is relatively lower at 6 months post vaccination in those tested animals. However, the BVDV antibody titer remained relatively high after 6 months from time of vaccination.

**4. Associated Knowledge Areas**

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

**Outcome #19**

**1. Outcome Measures**

Develop new strategies to increase immunity in animals through dietary supplementation of selenium and development of vaccines against influenza.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Our goal is to prevent diseases in cattle by optimizing immune function with supranutritional selenium (Se) biofortification. The objectives of this research are: 1) To determine if feeding pregnant beef cows Se-fortified alfalfa hay in the last 8 wk of pregnancy enhances passive transfer of IgG in beef calves. 2) To determine if there are health benefits (e.g., less disease morbidity and better weight gains) associated with this enhanced passive transfer of IgG in beef calves, from birth to weaning (approximately 6 months).

**What has been done**
The feeding trial, calving, and collection of samples occurred from December 10, 2014 to March 9, 2015 over a 13 week period. All selenium analyses have been completed. Calf productivity and immune studies are underway.

**Results**
A grant to support this study was submitted to USDA FY15 Animal Health and Disease Program for $15,536.00. The Project Director did not select this project for funding. We still plan to conduct a scaled back version of the project because the calves were already scheduled, hay had been purchased, and an ACUP was in place. The 8-week feeding trial begins October 9, 2015. Our goal is to prevent diseases in ruminants by optimizing immune function with supranutritional selenium (Se) biofortification. We propose to demonstrate that feeding Se-biofortified forage alters immune responses and health of weaned beef calves in a way that optimizes health before calves are shipped to a feedlot. During an 8 week backgrounding period, we will monitor blood Se levels, antibody titers to administered vaccinations, immune cell function assays, as well as morbidity and performance in calves fed control or one of two concentrations of Se-enriched hay.

Published Citations: We have finished other studies on the role of selenium in food animals.

Hall JA, Bobe G, Vorachek WR, Estill CT, Mosher WD, Pirelli GJ, Gamroth M. Effect of supranutritional maternal or colostral selenium supplementation on passive absorption of immunoglobulin G in selenium-replete dairy calves. J Dairy Sci 2014; 97(7):4379-91. doi: 10.3168/jds.2013-7481.

Brummer FA, Pirelli GJ, Hall JA. Selenium supplementation strategies for livestock in Oregon. EM 9094. Oregon State University Extension Service. June 2014. pp 1-9.

Hooper KJ, Bobe G, Vorachek WR, Bishop-Stewart JK, Mosher WD, Pirelli GJ, Kent ML, Hall JA. Effect of selenium yeast supplementation on naturally acquired parasitic infection in ewes. Biol Trace Elem Res 2014; 161(3):308-17. doi: 10.1007/s12011-014-0134-1.

Galbraith ML, Vorachek WR, Estill CT, Whanger PD, Bobe G, Davis TZ, Hall JA. Rumen microorganisms decrease bioavailability of inorganic selenium supplements. Submitted

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 301 | Reproductive Performance of Animals |
| 302 | Nutrient Utilization in Animals |
| 307 | Animal Management Systems |

| | |
|---|---|
| 311 | Animal Diseases |
| 502 | New and Improved Food Products |
| 903 | Communication, Education, and Information Delivery |

**Outcome #20**

**1. Outcome Measures**

Evaluate the toxicity of various mycotoxins in food.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Enterotoxin-producing Clostridium perfringens isolates have been associated with C. perfringens type A food poisoning, which currently ranks as the third most commonly reported food-borne illness in the USA. C. perfringens type A food poisoning is acquired when people consume a food (typically a beef or poultry product) contaminated with large numbers of vegetative cells of enterotoxigenic C. perfringens type A isolates. This single food poisoning affects more than 250,000 humans annually, and result in economical losses of over $120 million in the USA. C. perfringens also associated with gastrointestinal diseases in various species of animals. C. perfringens has the ability to form metabolically dormant spores that are extremely resistant to environmental stresses such as heat, radiation and toxic chemicals. However, to cause deleterious effects, dormant spores must first go through germination then outgrowth to be converted to vegetative cells. Although spore germination is a very crucial step for the pathogenesis of C. perfringens, no detail understanding of the mechanism of C. perfringens spore germination is available. Moreover, there are gaps on the fundamental knowledge on inactivation of C. perfringens spores using mild treatments such as, heat and disinfectants.

**What has been done**
Spore cortex hydrolysis by cortex lytic enzymes (CLEs) is the crucial step to complete spore germination. Two CLEs have been identified in C. perfringens spores, SleM and SleC. SleC is the essential CLEs for cortex hydrolysis of C. perf spores, however, SleM plays only a minor role. In this work we have examined the location of both pro-SleC and the Csp protease CspB in spores of the C. perfringens FP strain SM101 that contains only one Csp protease. In addition, the

numbers of pro-SleC and CspB molecules in spores have been determined.

In a process of developing spore inactivation strategy, we evaluated the inhibitory effects of chitosan against C. perfringens type A isolates associated with food poisoning. We already completed the study and manuscript is in preparation.

**Results**
The germination of C. perfringens spores and subsequently growth of germinated spores in food products are prerequisite factors for causing food poisoning by C. perfringens. Identification of SleC is the main CLE for germination of spores of FP strain SM101 makes this protein of interest for development of inhibitors, since such compounds would block spore germination and thus the ability of spores to cause disease. Also, a chemical like chitosan that can inhibit germination and outgrowth of spores would allow decontamination of C. perfringens spores in food products.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 311 | Animal Diseases |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 903 | Communication, Education, and Information Delivery |

**Outcome #21**

**1. Outcome Measures**

Use molecular breeding tools to develop resistance to abiotic and biotic stressors and to improve traits related to human health and nutrition in cultivars of importance in agriculture systems. a) Conduct a systematic evaluation of germplasm resources to identify sources of genetic variation i. Develop new high throughput markers anchored in genome sequences ii. Map genes/QTLs determining target traits iii. Characterize gene/QTL networks and interactions iv. Measure gene/QTL x environment interaction v. Validate and fine map putative genes/QTLs vi. Transfer identified genes/QTLs into economically useful backgrounds, using accelerated generation advance strategies

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Plant improvement is increasingly conducted in a data-rich environment, including large amounts of genetic, genomic and phenotypic data. Some of this data is from specific crops of interest and other data are transferred from other crop and model plant species. To be effective in their research, and well-prepared for a successful career, plant breeding and genetics students must learn the skills and expertise for accessing and integrating big data into their research and the ability to collaborate effectively with specialist data scientists.

**What has been done**
The Center for Genome Research and Biocomputing, directed by Brett Tyler, has developed a large selection of hands-on training workshops in data analysis. Students can enroll in these workshops for course credit under MCB 599. However, the classes are targeted not only to graduate students, but also to faculty and staff.

Regularly offered workshops include:
Introduction to Unix/Linux
Command Line Data Analysis (Pipelines and Regular Expressions)
Introduction to Programming with Perl
Introduction to Programming with Python (in two parts)
Introduction to Programming with R (in two parts)
Recursion, Dynamic Programming, and DNA
Techniques in RNA-Seq Analysis
Techniques in Genotyping-by-Sequencing Analysis

New undergraduate and graduate curricula in bioinformatics and data science.

Project Director Brett Tyler led a campus-wide task force from 2013 to 2015 charged with developing coordinated curricula in the general area of genomics, bioinformatics and systems biology. The task force recommended the establishment of a new undergraduate major in Bioinformatics and Data Science, and a new graduate minor in Biological Data Science.

**Results**
CGRB short courses in data analysis.

From 2012 to 2015, CGRB short courses have been attended by 105 faculty/staff, 141 postdocs and 430 graduate students. These include students, faculty and staff in the area of plant breeding.

New undergraduate and graduate curricula in bioinformatics and data science.

The new undergraduate major and the new graduate minor will both launch in Fall of 2016.The graduate minor in particular will strengthen the preparation of Ph.D. students entering graduate programs relevant to plant breeding and genetics such as Horticulture, Crop and Soil Science, and Molecular and Cellular Biology.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |

**Outcome #22**

**1. Outcome Measures**

Improve the nutritional value of important food grains; 2) reduce the impact of wheat storage proteins on human health; and 3) target nutrient development with ripening control. Examples at OSU include barley (Hayes and Ross), wheat (Zemetra, Flowers, and Ross), and grape (Deluc).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Climate change requires development of grain varieties able that are able to deal with volatile weather and novel stresses; provide expanded economic opportunities; and enable enhanced nutrition. Barley can be a key contributor to such healthy and productive agroecosystems due to versatility in end-use, broad adaptation, input efficiency, and abundant genetic resources.

**What has been done**
We have identified and deployed genes determining flowering time, cold tolerance, growth habit, and resistance to diseases in diverse germplasm. We have developed enhanced germplasm and barley varieties that provide growers with new crop opportunities, processors with new raw materials, and consumers with healthy and flavorful options.

**Results**
We have demonstrated that facultative growth habit (as defined by short day photoperiod sensitivity, no vernalization sensitivity, and the capability of induced cold tolerance) can provide

broad adaptation and flexibility. This growth habit allows for fall-planting and spring-planting of the same variety. We are promoting the concept of versatility in end-use by focusing on varieties without hulls. These varieties are directly suitable for food, provide enhanced flavor and efficiency in brewing, and greater nutritional value in feeds. We are demonstrating the use of facultative multi-use varieties in our malting facility and via baking and product development collaborations. We have created new germplasm (STRKR, FAC-WIN 6) and varieties (Alba, Buck) and extended knowledge of these resources via spoken, print, and electronic media.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 502 | New and Improved Food Products |

**Outcome #23**

**1. Outcome Measures**

The mission of the Ornamental Plant Breeding Program is to develop new cultivars that are ecologically sound for producers and consumers as well as economically viable for producers. We seek to develop sterile forms of non-native species, insect and disease resistant cultivars, and low input cultivars that can be grown in nurseries and landscapes with less water or nutrient inputs.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Climate change requires development of ornamental plants that are able to deal with volatile weather and novel stresses and provide expanded economic opportunities. Nursery crops can be a key contributor to such productive agroecosystems due to their wide use in commercial, municipal, and private landscapes.

**What has been done**
We are working to develop genetic resources including a draft genome and linkage map for ornamentals to identify markers associated with key ornamental traits to enhance adoption of plants bred for increased abiotic and biotic stress tolerance. Our applied breeding program has identified parental sources of resistance and demonstrated heritability of resistance to several pathogens.

**Results**
We have released our first cultivar that is an improved native cultivar. We are using this to create new cultivars with broader appeal. Many new polyploids that may have increased abiotic stress tolerance are being tested. Thousands of seedling selections are being tested for disease resistance. We have our selections being tested by approximately 15 collaborators including commercial nurseries, public gardens, and universities. These include multi-regional tests for adaptability.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 111 | Conservation and Efficient Use of Water |
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 603 | Market Economics |

**Outcome #24**

**1. Outcome Measures**

Fundamental Research Supporting Multiple Breeding Programs. Two research groups are engaged in fundamental research relevant to multiple breeding programs. These include seed dormancy and germination (Nonogaki) and a systems biology approach to stress tolerance (Jaiswal).

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Seeds provide more than 70% of world food supply. Seeds also contribute to our life through their utility as feed, fuel and fiber. Therefore, it is essential to understand seed development and secure sustainable seed production. Seed are also an important delivery system of genetic materials in agriculture, which is materialized through germination. There are many issues associated seed germination, such as low germination vigor due to seed dormancy or preharvest sprouting because of the lack of dormancy. Understanding the mechanisms of seed dormancy and germination

**What has been done**
Both basic and translational research has been performed. In basic research, coding and non-coding genes, which are regulated by abscisic acid (ABA), a seed dormancy hormone, have been characterized using RNA sequencing.

For translational biology, the dormancy inducible system, which had been established in our laboratory, in collaboration with Prof. Roger Beachy, World Food Center, UC Davis, was further modified. Application of the new system to wheat has been attempted.

**Results**
RNA sequencing in the basic research has identified novel long non-coding RNA (lncRNA), some of which are currently being characterized for their function. Chemically inducible gene expression lines have been created for a lncRNA. In addition, DELAY OF GERMINATION1-LIKE4 (DOGL4) gene has also been identified as an ABA-inducible gene. The dogl4 knockout plants were identified recently and will be used for phenotypic analysis.

For the translational biology, the spontaneous hyperdormancy system has been transferred to wheat, in collaboration with a Canadian group. We successfully obtained transgenic plants, which are currently subjected to phenotypic analysis. The goal is to prevent precocious germination, which is a serious food security issue.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 202 | Plant Genetic Resources |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 603 | Market Economics |
| 903 | Communication, Education, and Information Delivery |

**Outcome #25**

**1. Outcome Measures**

Evaluation of wheat cultivars for performance and resistance to stripe rust.

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
The alternative crops program is an effort to identify profitable alternative crops that can be successfully integrated into traditional wheat/fallow production areas in Umatilla County. In 2005, an organic wheat production study was initiated. The organic wheat market continues to experience growth and premium prices. The organic wheat research is part of the Organic Working Group at OSU that includes a combination of Extension faculty, researchers and organic producers.

**What has been done**
Research looking at organic wheat as an alternative crop began in 2005 and continued at the Blue Mountain Community College Ag Complex until 2010 and was expanded to include an on-farm trial at Nelson Farms in 2008 which continues today. The current research is being conducted as a cooperative effort with Stephen Machado, OSU Cropping Systems researcher from the Columbia Basin Ag Research Center in Pendleton, Oregon and Diana Roberts, Washington State University in Spokane, WA.

**Results**
Adoption of organic wheat production still faces many challenges in the dryland production system. I have two growers that rely on and use information from my organic research trials with combined production of about 3,500 acres. Farm visits and regular communication is helping these early adopters overcome some significant challenges.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 202 | Plant Genetic Resources |

| | |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |
| 205 | Plant Management Systems |
| 206 | Basic Plant Biology |
| 216 | Integrated Pest Management Systems |
| 502 | New and Improved Food Products |
| 601 | Economics of Agricultural Production and Farm Management |
| 603 | Market Economics |
| 903 | Communication, Education, and Information Delivery |

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

### External factors which affected outcomes

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

### Brief Explanation

The sharp increases in food prices that occurred in recent years, and the resulting increases in the number of hungry and malnourished people, have drawn attention to the fragility of the global food system and the vulnerability of food security. This awareness must be translated into effective action to render the system more resilient against various risk factors and to ensure that all of the world's growing population will have assured access to adequate food today and in the future. There is a need to address current and new challenges that transcend the traditional decision-making horizons of producers, consumers and policy-makers, both at national and global levels.
In the first half of this century, global demand for food, feed and fibre is expected to grow by 70 percent while, increasingly, crops may also be used for bio-energy and other industrial purposes. New and traditional demand will thus put growing pressure on already scarce agricultural resources. And while agriculture will be forced to compete for land and water with sprawling urban settlements, it will also be required to serve on other major fronts: adapting to and contributing to the mitigation of climate change, helping to preserve natural habitats and maintaining biodiversity.

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

### Evaluation Results

High throughput technologies for genotyping organisms such as plants and their pests and pathogens have dramatically accelerated in their power over the last two decades. This has been especially true for DNA sequencing and DNA-based genotyping methodologies. The cost of sequencing has dropped 10,000-fold over the last ten years as second

generation and third generation technologies have been introduced and have matured. The rapidly decreasing cost of sequencing is increasing the feasibility of whole genome sequencing and genotyping-by-sequencing (GBS). For example OSU participants in this project have used these tools for sequencing the Fragaria (Shulaev et al., 2011) and Brachypodium (Fox et al., 2013) genomes and detecting SNPs via restriction fragment amplification digests (RADs) in barley (Chutimanitsakun et al., 2011). In species with smaller genomes, larger numbers of individuals can now be genotyped by whole genome sequencing, providing access to millions of SNPs. For larger genomes and population sizes, reduced complexity sequencing can be used. These approaches are being used by OSU participants in two NIFA CAP projects (RosBREED and Triticeae CAP). A fourth generation of emerging sequencing technologies has the potential to drive costs down another 10-100-fold over the next five years.

Advances in genetic technology facilitate identification of genes determining the complex traits that will be targeted by breeding programs and allied research groups in addressing the challenges identified by this project. Candidate genes can be identified via genome wide association scanning (GWAS) and map-based cloning with reference to whole genome sequences. OSU researchers, for example, have identified candidate genes for low temperature tolerance QTLs in barley (vonZitzewitz et al., 2011) and eastern filbert blight resistance in hazelnut (Mehlenbacher et al., 2011). When coupled with the ever-expanding toolkit of analysis procedures, genomics resources allow for deeper mining of the phenotype data sets routinely generated by plant breeding programs and for the exploitation of high throughput phenotyping systems. As a consequence, molecular breeding strategies - such as marker-assisted selection (MAS) and genomic selection (GS) - are currently feasible in a range of economically important plants and are being used by OSU participants in this project. The OSU Center for Genome Research and Biocomputing (CGRB) plays a central enabling role in providing access to technology and analysis. For example, the CGRB is currently implementing a GBS pipeline that will play a central role in multiple GS projects.

## Key Items of Evaluation

In the coming years, agricultural research, extension and education will need to address the "constraints of a growing population, pressure on natural resources, and the challenges of climate variability and change...to increase agricultural and natural resource sustainability" as pointed out in the Agriculture and Food Research Institute (AFRI) Fiscal Year 13 Request for Applications in Food Security. There are many issues to address and resolve, including the uncertainties on the magnitude of climate change, the effects of technological changes on productivity, global food demands, and the numerous possibilities of new crops and new production areas for existing crops. Climate change is expected to lead to a net warming of the planet and increased volatility in temperature, moisture, and weather events. These factors will exacerbate the demands of food systems due to decreases in potential yields likely caused by shortening of the growing period, an overall decrease in water availability and changes in temperature-dependent physiological processes. Other challenges for agricultural research to address include:

- Achieving greater efficiencies in terms of water and nutrient usage
- Improving durable resistance to new pathogens and new strains of existing pathogens
- Improving resistance to abiotic stresses, including temperature, moisture, and salinity
- Developing maximum flexibility in cropping systems in response to changing patterns of land use and availability

The diversity of crops, environments and microclimates of Oregon and the Pacific Northwest afford our faculty and the Experiment Station the opportunity to investigate the challenges of crops important to both in Oregon and the world. Climate change is expected to provide additional diversity. Even in this increasingly complex scenario, there are unifying themes across the state, from the high rainfall valleys of the west to the deserts of the east. This "state-as-laboratory" provides an excellent model for integrating research targeting complex stresses. For example, on the west side more than 70 specialty crops have an annual farm-gate value of about $3 billion. Much of the east side winter wheat crop is dependent on stored soil moisture. Both cropping systems share challenges in terms of such fundamental processes as germination, growth and development, and seed biology. In turn, each of these biological phenomena can be addressed using fundamental research and breeding tools enabled by the CGRB.

## V(A). Planned Program (Summary)

**Program # 4**

### 1. Name of the Planned Program

Food Safety

☑ Reporting on this Program

### V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 133 | Pollution Prevention and Mitigation | 0% | | 5% | |
| 204 | Plant Product Quality and Utility (Preharvest) | 0% | | 5% | |
| 306 | Environmental Stress in Animals | 0% | | 5% | |
| 308 | Improved Animal Products (Before Harvest) | 0% | | 10% | |
| 311 | Animal Diseases | 0% | | 5% | |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals | 0% | | 10% | |
| 501 | New and Improved Food Processing Technologies | 0% | | 5% | |
| 502 | New and Improved Food Products | 0% | | 5% | |
| 602 | Business Management, Finance, and Taxation | 0% | | 5% | |
| 603 | Market Economics | 0% | | 5% | |
| 606 | International Trade and Development | 0% | | 5% | |
| 701 | Nutrient Composition of Food | 21% | | 5% | |
| 702 | Requirements and Function of Nutrients and Other Food Components | 0% | | 5% | |
| 703 | Nutrition Education and Behavior | 22% | | 5% | |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources | 0% | | 5% | |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins | 0% | | 5% | |
| 723 | Hazards to Human Health and Safety | 26% | | 5% | |
| 724 | Healthy Lifestyle | 26% | | 5% | |
| 903 | Communication, Education, and Information Delivery | 5% | | 0% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 6.0 | 0.0 | 25.0 | 0.0 |

| | | | | |
|---|---|---|---|---|
| **Actual Paid** | 11.0 | 0.0 | 30.0 | 0.0 |
| **Actual Volunteer** | 465.0 | 0.0 | 0.0 | 0.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 192194 | 0 | 453710 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 192194 | 0 | 4018008 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 573095 | 0 | 1547052 | 0 |

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

**1. Brief description of the Activity**

This program will result in multiple outputs as a result of the following proposed activities:

- Conducting laboratory, pilot-plant experiments and data collection
- Conducting research experiments
- Developing quality monitoring protocols
- Developing and applying new technology of food processing systems
- Developing products, curriculum, resources
- Developing services
- Presenting seminars and professional talks
- Conducting workshops and training sessions
- Publishing scientific findings
- Partnering
- Providing community education classes
- Maintaining a statewide food safety hotline
- Working with and supervising volunteers to deliver high quality information and programming about food safety topics

**2. Brief description of the target audience**

There are diverse audiences for the information this program generates. They can be classified into five general groups: (1) the general public and food consumers; (2) state and federal food regulatory agencies; (3) the research community including scientists working in government, industry, and academic sectors; (4) the commercial food processing industry and commodity groups; and (5) professional food handlers in organizations such as schools and other institutions, as well as restaurants.

**3. How was eXtension used?**

eXtension was not used in this program

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

### 1. Standard output measures

| 2015 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| Actual | 27465 | 72768 | 8230 | 27628 |

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

**Patent Applications Submitted**

Year: 2015

Actual: 0

**Patents listed**

### 3. Publications (Standard General Output Measure)

**Number of Peer Reviewed Publications**

| 2015 | Extension | Research | Total |
|---|---|---|---|
| Actual | 6 | 92 | 0 |

### V(F). State Defined Outputs

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Understand nutritional relationships to health and food safety, such as: a) mechanisms behind the health benefits of fruits and vegetables, b) novel dietary modifications to reduce the incidence of disease, c) role of antioxidants from berries in preventing health disease |
| 2 | Improve animal food production systems that impact food safety by a) improving diets to produce safer foods and human benefits, b) enhancing efficacy and safety of vaccination programs, c) developing diagnostic methods |
| 3 | Characterize and model pathogens and toxins in food and food systems, including: * agents and mechanisms * toxicity to animals or humans * mechanisms behind immune suppression |
| 4 | Improved food handling and regulations, including: * food production and handling practices * intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses |
| 5 | Improved animal husbandry that reduces food safety issues |
| 6 | Number of specialty food and mainstream food processors accessing and applying science based information to produce and distribute safe, nutritious, high-quality foods |
| 7 | Number of individuals improving their practices of safe food handling, food preparation, and food preservation |
| 8 | Number of technologies and control strategies that improve food safety |
| 9 | Ability to detect incidences and trace pathways of food borne illnesses |
| 10 | Number of policy makers and managers informed about safe food handling and processing |
| 11 | Identify Current traceability practices by small producers and processors |
| 12 | Identification of Critical Tracking Events (CTEs) and Key Data Elements (KDEs) |
| 13 | Identification of benefits and costs to implementing FTS |
| 14 | Training for Stakehoders |
| 15 | Implementation of Integrated Pest Management |

## Outcome #1

### 1. Outcome Measures

Understand nutritional relationships to health and food safety, such as: a) mechanisms behind the health benefits of fruits and vegetables, b) novel dietary modifications to reduce the incidence of disease, c) role of antioxidants from berries in preventing health disease

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Prevention of childhood obesity is a public health priority in the United States (US), with population disparities presenting unique challenges for prevention efforts. One such disparity is the higher prevalence of obesity among rural compared to non-rural children. The most current available evidence indicates that rural children have 26% greater odds of obesity compared to urban children, yet evidence to explain this disparity is inconclusive.

Behavioral and environmental factors in the family-home, such as those related to healthy eating, may influence children's risk for obesity. Among non-rural populations, evidence suggests associations between children's eating behaviors and family-level factors including parent education and role modeling, family food rules, and family meal patterns. Additionally, other home environmental factors, such as availability of healthy foods, eating while watching TV, and fast food consumption, may make it easier or harder for children to eat healthfully. Unfortunately, research examining these and other obesity-promoting or preventing factors in rural family-home settings is limited.

**What has been done**
The first aim of this cross-sectional study was to determine if family-home nutrition (FN) factors are associated with dietary intake (i.e., food groups and added sugars) in rural children. The second aim was to determine if food insecurity is associated with dietary intake in rural children. It was hypothesized that more favorable FN factors would be associated with healthier dietary intake and that being at-risk for food insecurity would be associated with less healthy dietary intake.

**Results**

The family-home environment is a key setting for the development of healthy eating behaviors that may influence weight status later in life. Findings from our study suggest that more favorable FN environments are associated with healthier dietary intakes among rural elementary school-age children. To promote healthy eating habits in rural family-home environments, parents and caregivers may implement strategies including offering vegetables, fruits, and low-fat dairy at meals and as snacks, ensuring that children eat breakfast and meals together as a family, and limiting the availability of soda and ready-to-eat foods at home.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 701 | Nutrient Composition of Food |
| 702 | Requirements and Function of Nutrients and Other Food Components |
| 703 | Nutrition Education and Behavior |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |

**Outcome #2**

**1. Outcome Measures**

Improve animal food production systems that impact food safety by a) improving diets to produce safer foods and human benefits, b) enhancing efficacy and safety of vaccination programs, c) developing diagnostic methods

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
This research will provide valuable information to hatchery personnel aimed at guiding disease prevention and management decisions, thus helping to create a more stable economic climate for producers in the aquaculture industry.

**What has been done**
Sample collection and initial processing will be conducted onsite at the hatcheries "(July and August) of consecutive production cycles (2016 and 2017) when higher throughout two months incidences of disease are expected. We intend to collect water from incoming water sources and active larval rearing tanks in the facility at designated time points throughout the growth cycle (2 - 3 weeks from fertilization to spat). Water samples will be collected from each tank during routine water exchanges and larval sieving after initial inoculation with fertilized eggs. Hatchery personnel will monitor tanks for overall health throughout the remaining growth cycle and, if healthy, additionally samples will be taken at days 8 and 14 post- inoculation of fertilized eggs. If disease events are detected in any tank, water will be collected from the affected rearing tank on that day. In addition, collection will be performed from all other apparently healthy tanks that were inoculated with the same batch of fertilized eggs. This will allow comparisons to be made between diseased and healthy tanks with other factors, such as water chemistry conditions, algal feed quality, incubation time, and oyster inoculate, being essentially equivalent.

**Results**
Overall, the results of this study will help to stabilize seed production in this rapidly growing and important economic sector, by providing producers with important new knowledge about the factors selecting for disease incidences.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 306 | Environmental Stress in Animals |
| 308 | Improved Animal Products (Before Harvest) |
| 311 | Animal Diseases |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #3**

**1. Outcome Measures**

Characterize and model pathogens and toxins in food and food systems, including: * agents and mechanisms * toxicity to animals or humans * mechanisms behind immune suppression

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Vibrio parahaemolyticus is a natural inhabitant of marine environments and frequently detected in molluscan shellfish, particularly oysters. This seafood-borne pathogen is the leading cause of acute human gastroenteritis associated with seafood consumption. The U.S. Centers for Disease Control and Prevention (CDC) estimated that 45,000 cases of V. parahaemolyticus infections occur each year in the U.S.

**What has been done**
Studies were conducted to investigate factors influencing efficacy of depuration and effects of temperature on high pressure processing for decontaminating Vibrio parahaemolyticus in oysters.

**Results**
The efficacy of high pressure processing in inactivation of V. parahaemolyticus cells in oyster homogenates was greatly enhanced by lowering the processing temperature to 5°C or lower. Efficacy of depuration for reducing V. parahaemolyticus levels in oysters was increased by decreasing water temperature to 12.5°C. Other factors, such as pH value and water volume, also affected the reductions of V. parahaemolyticus levels in oysters by the depuration process.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 308 | Improved Animal Products (Before Harvest) |
| 311 | Animal Diseases |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

## Outcome #4

### 1. Outcome Measures

Improved food handling and regulations, including: * food production and handling practices * intervention strategies reduce bacterial contamination, increase shelf life, and reduce occurrences of food-borne illnesses

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Agriculture is a knowledge intensive activity and producers are continually faced with new emerging issues, both positive and negative. Agricultural producers need up-to-date information that is accurate and reliable to address emerging problems, comply with changing government regulations and take advantages of new opportunities and technologies to improve their operations. Among the most critical regulatory issues that emerged in 2013 were the Food Safety Modernization Act (FSMA) and its proposed water quality standards that could restrict the use of irrigation water in the Treasure Valley of eastern Oregon and southwest Idaho and consequently devastate the area's critical onion industry.

**What has been done**
In addition to applied research, the OSU extension program focuses on educational programming to address the needs of agriculture in Malheur County and the surrounding region, and promote and improve it. In 2013, faculty assisted in organizing two workshops in Ontario that featured officials from the FDA, Oregon State University, Washington State University, ODA and ISDA, and were designed to help the public understand and comment on the new proposed FSMA rules. After the workshop, faculty assisted area growers in making comments to the FDA and drafted the comments submitted to the FDA by the Malheur County Onion Growers Association and the Idaho Onion Growers Association that provided science-based information on the safety of onion production and shipping practices.

In 2014, collaborations began with Clint Shock, Malheur Experiment Station, Joy Waite-Cusic, OSU, and Harry Kreeft, Western Laboratories, Parma, ID, to conduct research on understanding the potential for microbial contamination of onions and remediation methods to reduce bacterial levels in irrigation water, using available technologies and currently registered pesticides.

**Results**
The FSMA workshops were attended by over 360 people and gave FDA officials the opportunity to learn about onion production practices from a tour of onion farms. Partly in response to these events, FDA announced revisions the standards for Growing, Harvesting, Packing, and Holding of Produce for Human Consumption that would be more favorable for onion production in the Treasure Valley.

Our recent research has demonstrated that bacteria from irrigation water are not likely to be contaminating onion bulbs at the time of harvest. Our remediation research has shown there are "off-the-shelf" techniques growers could employ to reduce bacterial loads in irrigation water if that is ultimately required by FDA in the final FSMA rules.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 606 | International Trade and Development |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 903 | Communication, Education, and Information Delivery |

## Outcome #5

### 1. Outcome Measures

Improved animal husbandry that reduces food safety issues

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Action Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

Johne's disease, caused by Mycobacterium avium subspecies paratuberculosis (MAP), is a severe chronic enteritis which affects large populations of ruminants globally. Prevention strategies to combat the spread of Johne's disease among cattle herds involve adhering to strict calving practices to ensure young susceptible animals do not come in contact with MAP-contaminated colostrum, milk, or fecal material. Unfortunately, the current vaccination options available are associated with high cost and suboptimal efficacy. To more successfully combat the spread of Johne's disease to young calves, an efficient method of protection is needed. In this study, we examined passive immunization as a mode of introducing protective antibodies against MAP to prevent the passage of the bacterium to young animals via colostrum and milk. Utilizing the infectious MAP phenotype developed after bacterial exposure to milk, we demonstrate that in vitro opsonization with serum from Johne's-positive cattle results in enhanced translocation across a bovine MDBK polarized epithelial cell monolayer. Furthermore, immune serum opsonization of MAP results in a rapid host cell-mediated killing by bovine macrophages in an oxidative-, nitrosative-, and extracellular DNA trap-independent manner. This study illustrates that antibody opsonization of MAP expressing an infectious phenotype leads to the killing of the bacterium during the initial stage of macrophage infection.

**What has been done**

Understanding the pathogenic mechanisms of Mycobacterium avium subspecies paratuberculosis (MAP) and the host responses to Johne's disease is complicated by the multifaceted disease progression, late-onset host reaction, and the lack of available ex vivo infection models. We describe a novel cell culture passage model that mimics the course of infection in vivo. The developed model simulates the interaction of MAP with the intestinal epithelial cells, followed by infection of macrophages, and return to the intestinal epithelium. MAP internalization triggers no inflammatory response. After passage through a macrophage phase, bacterial re-infection of MDBK epithelial cells, representing the late phase of intestinal mucosal infection, is associated with increased synthesis of the pro-inflammatory transcripts of IL-6, CCL5, IL-8, and IL-18, paired with decreased levels of TGF-β. Transcriptome analysis of MAP from each stage of epithelial cell infection identified increased expression of lipid biosynthesis and lipopeptide modification genes in the inflammatory phenotype of MAP. Total lipid analysis by HPLC-ES/MS indicates different lipidomic profiles between the two phenotypes and a unique set of lipids composing the inflammatory MAP phenotype.

**Results**

The presence of selected upregulated lipid-modification gene transcripts in samples of ileal tissue from cows diagnosed with Johne's disease, supports validates the model. By using the relatively simple cell culture passage model, we show that MAP alters its lipid composition during intracellular infection and acquires a pro-inflammatory phenotype, which likely is associated with the inflammatory phase of Johne's disease.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 306 | Environmental Stress in Animals |
| 308 | Improved Animal Products (Before Harvest) |
| 311 | Animal Diseases |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |

**Outcome #6**

**1. Outcome Measures**

Number of specialty food and mainstream food processors accessing and applying science based information to produce and distribute safe, nutritious, high-quality foods

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

The proposed research will addresses organic blackberry production in the northwestern and southern USA (represent 91% of US acreage). There is a strong, emerging market for fresh and processed organic blackberry fruit, yet a lack of information on suitable organic production systems. Growers interested in the processed blackberry market have questions as to whether labor-saving machine harvesting technology can be used in organic systems when even beneficial insects could be harvest contaminants. Machine-harvested fruit are thought to be of more uniform ripeness and of better sensory quality than hand- harvested fruit, although this has not been proven. Little is known about the impact of cultivar response to organic production systems on nutritive/phytochemical value of fresh or processed fruit. Enterprise budgets are needed to determine whether best organic blackberry production systems are economically sustainable. There are no data on what organisms, if any, might be of concern for food safety in organic blackberry fields and whether there is a greater risk of food-borne illness in hand- or machine- harvested fruit. Finally, the potential liability cost and demand impact of a food-borne illness/safety issue in the blackberry industry is unknown; a forecast of potential economic costs

of a food safety issue, knowledge of potential food-borne organisms in blackberry production systems, and associated extension educational programming would likely be of great benefit. Many of our objectives , including those on weed, water, and nutrient management, as well as those on the impacts of hand vs. machine harvesting on fruit nutritive/phytochemical value and food safety, will be of great benefit to all blackberry growers using not only organic but also sustainable cultural practices. Our long-term goal is to develop organic production systems for processed and fresh-market blackberry that maximize plant growth, yield, fruit quality, and food safety; facilitate weed, water, and nutrient management; provide healthy and nutritious food; and provide economic benefit to growers.

**What has been done**

Research objectives of this project are to evaluate: Evaluate organic weed management, irrigation, and production systems for effectiveness on cane growth and production, root distribution, and availability of water and nutrients in machine-harvested trailing blackberry cultivars grown for processed markets. Assess the impact of organic production systems on incidence of insects and plant diseases in machine-harvested trailing blackberry. Measure and evaluate presence of any fruit contaminants and the impact on food safety in hand and machine harvested systems. Develop organically allowable post-harvest handling and processing practices to increase food safety as well as shelf-life of fresh fruit and quality of processed blackberry products. Determine the impact of organic production systems for various fresh and processed cultivars on the nutritional and health promotion (bioactive) compounds of blackberry fruit that are hand (processed and fresh) or machine harvested (processed) and measure the nutritional/phytochemical properties of organic blackberry fruit as affected by processing and packaging technology. Compare the effect of machine vs. hand harvesting on the sensory quality of processed organic blackberry fruit using a trained sensory panel. Extension and outreach objectives of the project are to: Develop economic enterprise budgets for establishment and management of organic blackberries for fresh and processed markets as affected by production method. Develop extension publications on reducing food-borne illness through pre- and post-harvest practices. Develop an economic model to assess the potential liability costs and demand impacts of a food safety issue in the fresh and processed blackberry industries in the U.S. Produce workshops, field days, publications, and web-based tools to effectively disseminate research findings to industry. Use eOrganic to facilitate communication of PDs and advisory board members and involvement of clientele during the project, and to package our research findings and traditional Extension activities (e.g. workshops, field days) into products that are useful to a national audience. Assess changes in grower knowledge, intentions, and practices resulting from the project.

**Results**

A trailing blackberry planting was established at OSU's NWREC to evaluate cultivar, weed management practices, deficit irrigation, and training time on growth, yield, fruit quality, and nutrient and carbon allocation. The planting was managed for a machine-harvested, processed fruit market from 2010-15 and was certified organic. Weed management affected growth and yield in all years. Plants in plots that were hand-hoed and those with weed mat as a mulch in the row produced 50% more primocanes than in non-weeded plots, but above-ground biomass was highest in weed mat. Weed mat led to 25% and 100% greater cumulative yield than hand-weeded and non-weeded, respectively. Hand-weeding and weed mat increased net returns by 40% and 71% compared to non-weeded, respectively. Yields in the weed mat treatment were similar to what would be expected in conventional production. Weed management strategy affected many nutrients in the soil, leaves, and fruit with weed mat often having the highest concentrations. Total aboveground biomass gain was 5.0 to 6.5 t/ha/year, while C stock was 0.4 to 1.1 t/ha in late winter. Nutrient losses were often higher than what was applied through fertilization, especially for N, K, and B, which would eventually lead to depletion of those nutrients in the planting. Black

Diamond had higher yield than Marion during establishment but there was no difference in the mature planting. Black Diamond was more susceptible to infestation with raspberry crown borer. Primocane training time did not affect yield of Black Diamond while in Marion, greater winter injury occurred in Aug.-trained plants than in Feb.-training. There was no impact of withholding irrigation after fruit harvest on yield, saving about 1 million L/ha of water over the 2 years. It also resulted in less freeze damage in Marion during a cold winter. In a grower collaborator study, fertilizer source (liquid fish and molasses blend; soy meal; and processed poultry litter) had no effect on yield and fruit quality.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 701 | Nutrient Composition of Food |
| 702 | Requirements and Function of Nutrients and Other Food Components |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |
| 903 | Communication, Education, and Information Delivery |

**Outcome #7**

**1. Outcome Measures**

Number of individuals improving their practices of safe food handling, food preparation, and food preservation

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|

2015 0

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
With many hours of volunteer assistance, the OSU Extension Service has disseminated research-based information on safe food handling to thousands of Oregonians for 25 years. This has averted foodborne illness (and medical bills) and prevented the expense of food waste.

**What has been done**
The Master Food Preserver (MFP) /Family Food Education (FFE) volunteer programs were launched in 1980 to support county food safety/preservation programing. The programs have been enhanced to include nutrition education. MFP and FFE Volunteers assist OSU Extension efforts at emergency food sites (food pantries) and in schools.

**Results**
n 2015, 396 new and veteran Master Food Preserver / Family Food Education volunteers contributed more than 26,494 hours of time in 26 counties, including Central Oregon (Deschutes, Crook, Jefferson); Baker, Clackamas, Coos, Curry, Douglas, Harney, Hood River, Jackson / Josephine, Klamath, Lake, Lane, Linn / Benton, Lincoln, Marion, Polk, Tillamook, Union, Washington, Wasco and Yamhill. Volunteers educated the public about safe food handling and preservation over the phone, at workshops, and at exhibits and demonstrations at sites such as farmers markets and county fairs. Over 41,408 contacts were made by volunteers, faculty and Extension staff, with 3,386 of these from callers seeking assistance from the Food Safety / Preservation Hotline. The Hotline is operated with volunteer assistance during the food preservation and holiday season. In addition, an estimated 149,930 Oregonians were reached by our faculty and volunteers through radio and television broadcasts, social media sites, and newspaper articles related to food preservation topics.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 701 | Nutrient Composition of Food |
| 702 | Requirements and Function of Nutrients and Other Food Components |
| 703 | Nutrition Education and Behavior |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |
| 903 | Communication, Education, and Information Delivery |

## Outcome #8

### 1. Outcome Measures

Number of technologies and control strategies that improve food safety

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Common environmental chemicals assumed to be safe at low doses may act separately or together to disrupt human tissues in ways that eventually lead to cancer, according to a task force of nearly 200 scientists from 28 countries, including one from Oregon State University.
In a nearly three-year investigation of the state of knowledge about environmentally influenced cancers, the scientists studied low-dose effects of 85 common chemicals not considered to be carcinogenic to humans.

**What has been done**
The researchers reviewed the actions of these chemicals against a long list of mechanisms that are important for cancer development. Drawing on hundreds of laboratory studies, large databases of cancer information, and models that predict cancer development, they compared the chemicals' biological activity patterns to 11 known cancer "hallmarks" - distinctive patterns of cellular and genetic disruption associated with early development of tumors.

The chemicals included bisphenol A (BPA), used in plastic food and beverage containers; rotenone, a broad-spectrum insecticide; paraquat, an agricultural herbicide; and triclosan, an antibacterial agent used in soaps and cosmetics.

In their survey, the researchers learned that 50 of the 85 chemicals had been shown to disrupt functioning of cells in ways that correlated with known early patterns of cancer, even at the low, presumably benign levels at which most people are exposed. For 13 of them, the researchers found evidence of a dose-response threshold - a level of exposure at which a chemical is considered toxic by regulators. For 22, there was no toxicity information at all.

**Results**

The main purpose of this study was to highlight gaps in knowledge of environmentally influenced cancers and to set forth a research agenda for the next few years. More research is still necessary to assess early exposure and to understand early stages of cancer development.

Traditional risk assessment has historically focused on a quest for single chemicals and single modes of action - approaches that may underestimate cancer risk. This study takes a different tack, examining the interplay over time of independent molecular processes triggered by low-dose exposures to chemicals.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 703 | Nutrition Education and Behavior |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |

**Outcome #9**

**1. Outcome Measures**

Ability to detect incidences and trace pathways of food borne illnesses

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
While traditional food safety methods rely mostly on chemical preservatives to combat disease microbes, OSU researchers are searching for natural ingredients that do the same thing. These approaches are revolutionizing the food industry by providing alternative uses for foods while cutting production costs.

**What has been done**
Research has been directed at using a series of obstacles that will cumulatively wear down microbes without using chemicals and without affecting the quality of the food product. Simple treatments such as heating slightly or decreasing moisture content can stress microbes and inhibit their growth. Natural antimicrobials can provide a final blow.

**Results**
Research has focused on a group of bacterial proteins, called bacteriocins, that have the ability to destroy bacteria. One well-studied bacteriocin called nisin attacks bacteria that can cause deadly outbreaks of food poisoning, such as botulism and listeria. Searching for new uses, OSU researchers found that coating food processing equipment with nisin can help prevent microbial spoilage. They found that nisin, as well as an enzyme called lysozyme, which occurs naturally in egg whites, can function as effective natural preservatives in beer and wine.

Electrolyzed water has been discovered as a powerful antimicrobial agent for fresh vegetables and researchers have found that anything with strong sensory response is a likely candidate to have antimicrobial properties :spices, garlic, orange peels, even sauerkraut. And by using one kind of food to preserve another kind of food, this research circumvents the costly process of chemical development and testing. The cost of developing a food-based preservative, for example, can be one-tenth the cost of chemical additive development. And developing alternative uses for existing food products adds value with no extra cost.

## 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |

**Outcome #10**

**1. Outcome Measures**

Number of policy makers and managers informed about safe food handling and processing

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Current monitoring data and spatial analysis efforts are inadequate to conduct a robust evaluation of the potential risks to aquatic life associated with pesticide use practices, in formulating risk management strategies for the protection of aquatic resources. Spatial and temporal analysis, continuous monitoring, and environmental fate modeling will be used to evaluate pesticide fate at the watershed scale to provided to state and local agencies and producers a better understanding of the relationship between agronomic and other land use practices and the potential for surface water loading. These technologies will also form a framework for engaging pesticide users in the evaluation of alternative integrated pest management (IPM) and pesticide best management practices (BMPs) that meet both production and environmental protection goals.

**What has been done**
Spatial (GIS) and temporal analysis, and environmental fate modeling will be used to characterize pesticide use practices, climatic and edapic conditions, landscape, and ecohydrology at the watershed scale to estimate patterns in pesticide loading relative to life-histories of key aquatic species (i.e., listed salmonids) and their food web. Modeling outcomes will be evaluated using continuous environmental monitoring employing trace analytical methods. These technologies will form a framework for engaging pesticide users in the evaluation of alternative integrated pest management (IPM) and pesticide best management practices (BMPs) that meet both production and environmental protection goals.

**Results**
These modeling and monitoring technologies willl be used to assess opportunities for exposrure in aquatic ecosystems and to develop technologies that estimate and mitigate adverse human and environmental impacts. Expected outcomes are the adoption of crop management practices and mitigation measures that meet production goals, result in a reduction in surface water loading

of high risk pesticides, and allow for less conservative regulatory strategies.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 306 | Environmental Stress in Animals |
| 308 | Improved Animal Products (Before Harvest) |
| 311 | Animal Diseases |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |
| 903 | Communication, Education, and Information Delivery |

## Outcome #11

### 1. Outcome Measures

Identify Current traceability practices by small producers and processors

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Need for on-site analytical technologies enhancing traceability and useful in focusing outreach by grower-shipper processor organizations, cooperatives, and university Extension on GAPs that will

reduce the overall pesticide load entering food processing facilities.

**What has been done**
With funding from the National Institute of Health (SBIR Phase II Sub-award contract NIH 2R44ES018132) we completed the development of gas chromatography (GC) with mass selective detection (MSD) and nitrogen-phosphorus detection (NPD) methods for the measurement of malathion and chlorpyrifos residues in apple fruit and juice. These methods employ the QuEChERS method for sample extraction, clean-up, and enrichment. These QuEChERS/GC methods will be used to evaluate the performance of the ECM 300, a prototype device employing a biosensor for multifrequency electrochemical impedance spectroscopy measurements, now in beta testing. The ECM 300 is designed as accessible technology for on-site measurement of selected the organophosphate pesticides in fruit and juice. Data quality objectives meeting GLP and GMP goals will be used to compare results from the analysis of duplicate samples analyzed by GC and ECM 300 methods, as well as evaluate the ECM 300 with regards to performance necessary to meet commercialization goals, including low-cost, rapid turnaround analysis that can be conducted on-site by food science technicians.

**Results**
It is anticipated that publications and conference presentations will be forthcoming when ECM 300 development is closer to commercialization.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 903 | Communication, Education, and Information Delivery |

**Outcome #12**

**1. Outcome Measures**

Identification of Critical Tracking Events (CTEs) and Key Data Elements (KDEs)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Along with increased consumers' demands in excellent eating quality, high standards on food safety and nutritional value in processed foods, it requires a continuous improvement in conventional processing technologies and the development of new alternatives. This project will investigate existing food processing technologies and developing new and novel technologies for providing food with highest retention in nutritional and eating qualities of food while eliminating foodborne pathogens and spoilage microorganisms for ensuring food safety, enhancing food quality and extending shelf-life of processed foods. Meanwhile, new value-added applications of low value food items and food processing biowaste will be developed to help the increase of economic benefit of food industry and sustainability of food processing. In addition, outreach programs will be implemented to disseminate best practices for enhancing food safety and quality to stakeholders.

**What has been done**
Through investigating the chemical composition, bioactive compounds, and functional properties of food and food processing byproducts, it will develop new knowledge and potential new applications of food and food processing biowaste, and help convert low value food items and biowastes into high value-added products. This would not only benefit the economics, but also increase agricultural sustainability by reducing the impact on environmental pollution.

By studying advanced thermal and non-thermal food processing technologies, new value-added food products (seafood, dairy products, and fruit and vegetable based products) will be developed for ensuring food safety and quality, extending shelf- life, and increasing nutritional value and health benefits of a wide range of food items to consumers.

By disseminate new technologies and products to stakeholders and consumers through extension education and training programs, it will enhance food safety and quality of commercial food products and increase nutrition and health benefits of foods to consumers.

**Results**
This is a newly initiated project and preliminary projects will be reported during the next reporting period.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 603 | Market Economics |
| 701 | Nutrient Composition of Food |
| 702 | Requirements and Function of Nutrients and Other Food Components |
| 703 | Nutrition Education and Behavior |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 724 | Healthy Lifestyle |
| 903 | Communication, Education, and Information Delivery |

**Outcome #13**

**1. Outcome Measures**

Identification of benefits and costs to implementing FTS

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**

As the Food Safety Modernization Act moves forward, so will programs designed to help with its implementation. Oregon State University will administer a new $1.2 million center that aims to help small and midsized farms and food processors in 13 states prevent illnesses. This is part of an effort to help growers of fruits, vegetables and nuts comply with requirements established under the Act.

**What has been done**
OSU and its partners will work with The Produce Safety Alliance and the Food Safety Preventive Control Alliance to develop trainers. The aim is to have at least two dozen lead trainers and about 200 other people as certified trainers. The trainers could include representatives from regulatory agencies, nongovernmental organizations and commodity group associations. The center is a partnership with land-grant universities in Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming and Guam as well as American Samoa Community College.

**Results**
Because this effort has just begun, results will be reported during the next reporting period.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 501 | New and Improved Food Processing Technologies |
| 502 | New and Improved Food Products |
| 602 | Business Management, Finance, and Taxation |
| 603 | Market Economics |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 903 | Communication, Education, and Information Delivery |

## Outcome #14

### 1. Outcome Measures

Training for Stakehoders

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Utilizing input received from the cranberry focus group, the Oregon Cranberry Growers Association, Extension personnel, and field scientists, faculty will facilitate the development of educational programming that targets cranberry growers in Coos and Curry counties. In 2015, this will include the annual Cranberry School, at which the most recent research in local cranberry production and pest control will be discussed. Current restrictions on chlorothalonil use will require the growers to be educated on alternative fungicide programs in order to minimize costs, maintain qualifications for export, and minimize risk of fungal resistance.

**What has been done**
Faculty worked closely with the Oregon Cranberry Growers Association (OCGA), Ocean Spray personnel, Extension Specialists, and a local cranberry focus group to identify basic management areas that could be addressed: fertilization and pest management. This year we scheduled three informal discussion meetings (Twilight Meetings) geared toward getting producers together in a round-table session that allowed them to discuss their current management strategies and compare those to research-based recommendations. These meetings also provided growers and advisers the opportunity to voice questions and concerns and hear about new pests and production issues.

**Results**
Faculty organized the annual winter Cranberry School in February 2015. Nine speakers presented, representing University of Massachusetts, Washington State University, Oregon State University, Ocean Spray, and Oregon Department of Agriculture and Department of Environmental Quality. Topics included weed identification and control, fungicide updates/reduced use, nutrient management, pollinator protection, and the pesticide stewardship program. 83 growers attended.

NACREW conference (international meeting). OSU organized the international North American Cranberry Researcher and Extension Worker conference held August 23-26, 2015, in Bandon, OR. This is a conference that is held every other year; in 2013 it was held in Quebec. Historically, growers have not been invited to the meeting, but OSU wanted the meeting to provide an opportunity for researchers and growers to share information and interact, so we opened registration to include growers. One grower flew from Massachusetts to attend. Approximately 15 local cranberry growers attended as well. The meeting provides an opportunity for current research in the cranberry industry to be presented and discussed. Both the presenters and the growers provided feedback that was positive. 70 people were in attendance.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 204 | Plant Product Quality and Utility (Preharvest) |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 502 | New and Improved Food Products |
| 602 | Business Management, Finance, and Taxation |
| 702 | Requirements and Function of Nutrients and Other Food Components |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and |

| | |
|---|---|
| | Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 903 | Communication, Education, and Information Delivery |

**Outcome #15**

**1. Outcome Measures**

Implementation of Integrated Pest Management

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
The goals of the being addressed State IPM Coordination program is to advance PAMS IPM in all of its applications in Oregon: the critical needs include development of statewide partnerships to enable the benefits of IPM to be leveraged in the marketplace, and establishment of a more integrated suite of decision support tools that enable farmers to respond to increasing uncertainties in climate, pests and markets. The goals of the Specialty Crop IPM component of this program are to engage in effective pesticide stewardship partnerships with farmers, state agencies and stakeholders to maximize the impact of IPM in pest suppression and also environmental protection, and 2) to increase adoption of biologically-based IPM. The critical needs addressed include high pesticide residues in streams, and a critical lack of local knowledge concerning conservation biological control practices.

The goal of the school IPM component is a healthier environment for the preK-12 school community through a reduction in pests, pesticide use, and pest management costs. The critical needs being addressed are that PreK-12 School IPM Coordinators need to be able to train custodians more effectively, health inspectors need to know more about pests and pest-conducive conditions and school nurses and others in the school community need to understand the basic characteristics and health risks associated with bed bugs and their management.

**What has been done**
This program addressed skills in pesticide use reduction and risk mitigation, derived from outcomes-based education program planning exercises undertaken separately with Christmas

Tree and nursery industry groups. A new pest phenology model was developed, to optimize use of pesticides against Douglas Fir needle midge, comprehensive pesticide risk assessments were undertaken to guide pesticide selection by nursery and Christmas Tree producers, and a climate analysis for the area, enabled a locally-specific pesticide drift management guide to be produced. Six of the workshops, in the Clackamas Watershed, attracted 189 participants, who participated in an intensive at, and post event evaluation. At events, 64% of participants expressed an intention to adjust spray timing, 50% to use lower risk pesticides, and 58% to reduce spray frequency. The workshops were reinforced by a vehicle mounted windsock distribution, and a pesticide nozzle replacement cost share program. One year following the education program, 47% of Christmas tree growers, and 90% of nursery producers had used on line weather forecasting, 78%/90% had adjusted application timing based on weather, 53%/90% had adjusted application practices to protect sensitive sites, and 32%/58% used less chlorpyrifos. Independent monitoring of the Clackamas River for chlorpyrifos in 2014 showed no detections for the first time since 2005, and a reduction in pesticides detected from 18, to 8.

**Results**

We conducted IPM training for health inspectors in Oregon City on 3/26/14 and Bend on 7/31/15, which included pests of public health concern, pest prevention, monitoring, and hands-on inspections of school kitchens and concession stands. There were 25 attendees total. 92% reported learning at least one thing they will put into practice in their work, and they plan to share with other colleagues at least one practice they learned.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 133 | Pollution Prevention and Mitigation |
| 204 | Plant Product Quality and Utility (Preharvest) |
| 314 | Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals |
| 711 | Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources |
| 712 | Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins |
| 723 | Hazards to Human Health and Safety |
| 903 | Communication, Education, and Information Delivery |

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

**External factors which affected outcomes**

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

### Brief Explanation

Future lifestyles will emphasize maintaining health and preventing diseases that now limit human lifespan. As our understanding of the complex relationships between diet and health expands, markets will grow for safe, highly nutritious foods and for functional foods and biopharmaceuticals that have disease prevention and health promotion effects. Our existing strengths in areas such as biotechnology and genomics, agricultural production systems, food processing and food safety, environmental toxicology and agricultural marketing, trade, and economics position the Oregon Agricultural Experiment Station to further understand and develop the agriculture and food system in Oregon and the region. A combination of conventional, organic, and biotechnology-based approaches will provide an array of strategies for sustainable production of nutritionally enhanced crops and food. These agricultural and food products will ensure a range of marketing niches for producers while providing the consumer with robust choices within a safe and secure food system. Research will support producers and marketers in the production of certified organic and health-enhanced foods. Research will also provide analyses of health effects of agricultural and environmental chemicals as well as the use of foods and phytonutrients to maintain well-being. Expanded consumer education about the relationships of food, nutrition, and health will provide U.S. citizens with information for making individual choices among an array of foods and food products.

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

### Evaluation Results

Food is complicated--culturally, politically, and economically. A food systems approach is a key strategy for enhancing rural and urban community sustainability. It also integrates and amplifies the foundational strengths of OSU and its delivery model in communities and across the state. Food, essential to all Oregonians, is a handshake between rural and urban communities. The knowledge base of OSU Extension and OSU research in agricultural sciences and public health can help communities increase food security, diversify food choices and sources, and enhance economic development related to food and farming.

### Key Items of Evaluation

OSU has significant expertise, strength and presence in the 36 counties across the state as a statewide public service agency. The OSU Center for Small Farms and Community Food Systems and the College of Public Health and Human Sciences can integrate OSU's agricultural and public health expertise to enhance food systems statewide. By providing leadership and coordination between the myriad of organizations within the food system, reconnecting farmers and consumers in order to benefit farmers, strengthen rural and urban communities, promote healthy eating and food security, and protect natural resources, OSU will contribute significantly as a leader in the food systems framework.

## V(A). Planned Program (Summary)

**Program # 5**

**1. Name of the Planned Program**

Childhood Obesity

☑ Reporting on this Program

**V(B). Program Knowledge Area(s)**

1. Program Knowledge Areas and Percentage

| KA Code | Knowledge Area | %1862 Extension | %1890 Extension | %1862 Research | %1890 Research |
|---|---|---|---|---|---|
| 610 | Domestic Policy Analysis | 8% | | 0% | |
| 703 | Nutrition Education and Behavior | 42% | | 25% | |
| 704 | Nutrition and Hunger in the Population | 4% | | 25% | |
| 724 | Healthy Lifestyle | 11% | | 25% | |
| 802 | Human Development and Family Well-Being | 6% | | 10% | |
| 806 | Youth Development | 21% | | 15% | |
| 901 | Program and Project Design, and Statistics | 4% | | 0% | |
| 903 | Communication, Education, and Information Delivery | 4% | | 0% | |
| | **Total** | 100% | | 100% | |

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

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

| Year: 2015 | Extension | | Research | |
|---|---|---|---|---|
| | 1862 | 1890 | 1862 | 1890 |
| **Plan** | 6.0 | 0.0 | 1.0 | 0.0 |
| **Actual Paid** | 11.0 | 0.0 | 10.0 | 0.0 |
| **Actual Volunteer** | 714.0 | 0.0 | 0.0 | 0.0 |

**2. Actual dollars expended in this Program (includes Carryover Funds from previous years)**

| Extension | | Research | |
|---|---|---|---|
| **Smith-Lever 3b & 3c** | **1890 Extension** | **Hatch** | **Evans-Allen** |
| 192194 | 0 | 225404 | 0 |
| **1862 Matching** | **1890 Matching** | **1862 Matching** | **1890 Matching** |
| 192194 | 0 | 1999189 | 0 |
| **1862 All Other** | **1890 All Other** | **1862 All Other** | **1890 All Other** |
| 573095 | 0 | 1037090 | 0 |

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

### 1. Brief description of the Activity

We will determine factors that drive the decisions of individuals and householders to adopt and maintain healthy lifestyle choices. Further, we will use a social-ecological framework to study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as acceptability.

We will also:

• Conduct evidence-based educational programs and activities that are directed at parents, children, professionals, partner agencies, and other audiences.
• Develop or select new 4-H foods curricula that focus on the youth learning to prepare healthy, local foods.
• Develop a curriculum designed to help older youth become local advocates for healthy eating and physical activity in their communities. The curriculum will help young people learn how to conduct community assessments and lead community change efforts that focus on education, system building, and policy development.

In summary, we will:
- Conduct surveys
- Conduct data analyses
- Conduct mixed-methods longitudinal research (interviews,
- Conduct Research Experiments
- Develop models
- Develop Products, Curriculum, Resources
- Provide Training.
- Assessments.
- Partnering
- Partnering.

### 2. Brief description of the target audience

- children, youth, and families across Oregon
- schools and others youth educators
- elderly residents
- urban and rural residents
- Latino populations
- economists.

- policy makers and agency personnel who work with children and families .

**3. How was eXtension used?**

eXtension was not used in this program

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

**1. Standard output measures**

| 2015 | Direct Contacts Adults | Indirect Contacts Adults | Direct Contacts Youth | Indirect Contacts Youth |
|---|---|---|---|---|
| **Actual** | 0 | 0 | 0 | 0 |

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

**Patent Applications Submitted**

| | |
|---|---|
| Year: | 2015 |
| Actual: | 0 |

**Patents listed**

**3. Publications (Standard General Output Measure)**

**Number of Peer Reviewed Publications**

| 2015 | Extension | Research | Total |
|---|---|---|---|
| **Actual** | 0 | 44 | 0 |

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

**Output Target**

**Output #1**

**Output Measure**

- {No Data Entered}

**V(G). State Defined Outcomes**

## V. State Defined Outcomes Table of Content

| O. No. | OUTCOME NAME |
|---|---|
| 1 | Conceptual model will guide research to understand the factors & processes that account for physical activity and the associated health outcomes among youth across ethnic and class boundaries in the context of changing communities |
| 2 | Knowledge gained to develop strategies for maximizing physical activity and physical and mental health of youths and adults |
| 3 | Improved outreach, education, and professional practice to serve the needs of low-income families, including programmatic interventions that reduce physical inactivity and promote the well-being of lower-income and ethnic minority youth across America |
| 4 | Develop understanding of human health and nutritional behaviors * obesity intervention strategies * bio-behavioral markers * key parent-child relationships * family interactions * peer interactions * personal choices |
| 5 | Improved nutrition * schools offer/encourage healthful foods * more effective programs and student experiences * markers and strategies become the standards of methods and measurement of childhood overweight and resiliency |
| 6 | Identify tactics, strategies and factors that provide families, children, and youth access to healthy foods |
| 7 | Children practice healthy eating as defined by the current U.S. Dietary Guidelines for Americans (Percent of target audience indicating positive change in measured outcome) |
| 8 | Children engage in healthy levels of physical activity as defined by national physical activity guildeines (Percent of target audience indicating positive change in measured outcome) |
| 9 | Increases in positive levels of Knowledge, Attittude, Skills and Aspiration (KASA) outcomes, as per Bennett & Rockwell, 1995, related to goals of reducing obesity (Percent of target audience indicating positive change in measured outcome) |

**Outcome #1**

**1. Outcome Measures**

Conceptual model will guide research to understand the factors & processes that account for physical activity and the associated health outcomes among youth across ethnic and class boundaries in the context of changing communities

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Achieving adequate calcium intake, particularly during early adolescence (10 to 13 years old), is essential for reaching peak bone mass and reducing risk for osteoporotic fracture later in life (Power et al., 1999). Unfortunately, most U.S. early adolescents fail to meet the daily calcium RDA of 1,300 mg (NIH Office of Dietary Supplements, 2011). As nutrition gatekeepers in the home, parents play an important role in helping children achieve adequate calcium from calcium-rich foods and beverages (CRF/B) (Larson, Story, Wall, & Neumark-Sztainer, 2006). Interview data indicate that parents of early adolescents employ specific strategies, such as setting expectations for intake of CRF/B, making CRF/B available, and preparing CRF/B foods, to promote adequate intake of CRF/B in their child (Edlefsen et al., 2008). Several of these strategies were positively associated with calcium intake among children (Larson et al., 2006; Larson et al., 2009).

**What has been done**
In a previous study, in-depth interviews were conducted with non-Hispanic White, Hispanic, and Asian parents/caregivers of early adolescents to assess parenting practices regarding consumption of CRF/B by children (Edlefsen et al., 2008); meal patterns at and away from home (Cluskey et al., 2008a); and knowledge regarding calcium needs for parents and adolescents (Cluskey et al., 2008b). Findings were used to develop items for a quantitative parent questionnaire based on two major constructs: attitudes or preferences regarding parental intake of CRF/B = individual variables and socio-environmental factors regarding child intake of CRF/B = family variables. Researchers tested items for clarity and understanding, and revised as needed based on results from individual cognitive interviews with parents of varying race or ethnic background (9 Asians, 13 Hispanics, and 13 non-Hispanic Whites) across seven states. Items were used to construct 14 subscales that met standards for psychometric properties with

Cronbach a-coefficients of 0.50-0.79 and Pearson correlation test-retest reliability coefficients of 0.68-0.85 (Reicks et al., 2011). Items included in subscales were reviewed for content appropriateness by experts at 10 universities.

**Results**

In summary, findings from the study reported here demonstrate that parents with less education and born outside the U.S. have lower calcium knowledge scores, suggesting that these individuals are in higher need of intervention. Higher knowledge scores among non-Hispanic Whites compared to other groups support the importance of a focused calcium education program directed toward Asian and Hispanic parents. Having a girl was associated with greater calcium knowledge among parents, which suggests many parents are successfully attending to the information they receive from health professionals regarding the importance of adequate calcium intake. Parents with greater calcium knowledge were more likely to make CRF/B available, set expectations for CRF/B intake and encourage consumption of CRF/B pointing to the critical role of nutrition education in establishing these positive parent practices.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 610 | Domestic Policy Analysis |
| 703 | Nutrition Education and Behavior |
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |
| 901 | Program and Project Design, and Statistics |
| 903 | Communication, Education, and Information Delivery |

**Outcome #2**

**1. Outcome Measures**

Knowledge gained to develop strategies for maximizing physical activity and physical and mental health of youths and adults

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Pilot testing a 2-year obesity prevention intervention with soccer players (14-19y).

**What has been done**
Fifty-two teens enrolled and completed baseline assessments. The intervention group (n=26) received face-to-face sports nutrition and lifeskill-building lessons and accessed the virtual world. Integrated technologies include: wearable sensors to measure heart rate, movements, and/or body temperature; a cloud-service system to capture Fitbit data; and virtual 3-D avatar- simulated learning activities to reinforce face-to-face learning.

**Results**
As expected, the intervention reduced sedentary behaviors, improved nutrition and physical behavior.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |
| 903 | Communication, Education, and Information Delivery |

## Outcome #3

### 1. Outcome Measures

Improved outreach, education, and professional practice to serve the needs of low-income families, including programmatic interventions that reduce physical inactivity and promote the well-being of lower-income and ethnic minority youth across America

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**

Compared to non-Hispanic whites in the United States, Latinos are more likely to be overweight or obese, less physically active and to develop diabetes and end-stage renal disease (Ricardo et al. 2011) . Overweight and obesity are risk negative health outcomes for adults (Kimokoti and Millen 2011), and foreign-born Mexican-American adolescents had the greatest risk of weight gain with acculturation to the United States (Larsen et al. 2003). This suggests that when Latinos immigrate to the United States, the increased risk for developing chronic disease occurs with health-related consequences of lifestyle changes. Therefore, understanding more about the process of dietary acculturation for this population is valuable.

**What has been done**

Ten mothers participated in the individual interviews, which were all conducted in Spanish, and the researcher of Latina descent was most successful at personal face-to-face recruitment. All respondents were foreign-born, first-generation Hispanic female immigrants to the United States whose parents were all born outside the United States. Table 2 provides demographic information for the participants. The interviews were recorded, translated, and then coded for thematic analysis. Two investigators separately coded the interviews and arrived at common themes (Bernard 2006). Three themes emerged reflecting changes related to the complex process of relocating to a new environment and the impact upon dietary behaviors.

**Results**

In this study, parents revealed that the impacts of immigration involved lifestyle, attitude, and dietary changes, and that maintaining native foods and Spanish language skills is an important way to carry on cultural traditions. We found that dietary changes in families related to lifestyle as well as exposure and access to new and sometimes less healthy foods. Children are the primary drivers of the family trying new American foods. Others have reported acculturated Latino children's diets to be of lower quality (Perez-Escamilla 2009), as the parents are more likely to maintain traditional diets, which are often healthier. These subjects indicated that family food favorites are homemade Latino rather than American foods, and the mothers in this study tried to maintain those but also find that cooking is too time consuming and US ingredients lack flavor and freshness. These subjects described both positive and negative dietary changes after long-term immigration, which has been reported elsewhere (Gray et al. 2005; Perez-Escamilla and Putnik 2007). The longer he or she lives in the new country, the more an immigrant's health status tends to resemble the dominant culture (Singh and Siahpush 2002; Arcia et al. 2001) . Deterioration of diet quality has been seen with acculturation (Perez-Camilla 2009) but determining why that occurs is confounded by the ability to measure acculturation and discern the impact of various moderating variables such as income, education, and residency. Generally, mothers in this study seemed to acknowledge the potential health risk to their family with changing lifestyles and diets, but report many challenges to keeping the traditional diet.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 610 | Domestic Policy Analysis |
| 802 | Human Development and Family Well-Being |
| 901 | Program and Project Design, and Statistics |
| 903 | Communication, Education, and Information Delivery |

## Outcome #4

### 1. Outcome Measures

Develop understanding of human health and nutritional behaviors * obesity intervention strategies * bio-behavioral markers * key parent-child relationships * family interactions * peer interactions * personal choices

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

### 3a. Outcome Type:

Change in Knowledge Outcome Measure

### 3b. Quantitative Outcome

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
The regulation of appetite and energy intake is influenced by numerous hormonal and neural signals, including feedback from changes in diet and exercise. Exercise can suppress subjective appetite ratings, subsequent energy intake, and alter appetite-regulating hormones, including ghrelin, peptide YY, and glucagon-like peptide 1(GLP-1) for a period of time post-exercise. Discrepancies in the degree of appetite suppression with exercise may be dependent on subject characteristics (e.g., body fatness, fitness level, age or sex) and exercise duration, intensity, type and mode. Following an acute bout of exercise, exercise- trained males experience appetite suppression, while data in exercise-trained women are limited and equivocal. Diet can also impact appetite, with low-energy dense diets eliciting a greater sense of fullness at a lower energy intake. To date, little research has examined the combined interaction of exercise and diet on appetite and energy intake. This review focuses on exercise-trained men and women and examines the impact of exercise on hormonal regulation of appetite, post-exercise energy intake, and subjective and objective measurements of appetite. The impact that low-energy dense diets have on appetite and energy intake are also addressed. Finally, the combined effects of high-intensity exercise and low-energy dense diets are examined.

**What has been done**
This review focuses on exercise-trained men and women using only those studies clearly describing the fitness level of the participants (e.g., athlete, exercise-trained) and/or providing VO2max values indicating a high level of fitness. Because of these stringent criteria, some studies that reported "active" participants were not included because their level of fitness and exercise training could not be confirmed based on the data provided. First, we examine the impact of exercise on hormonal regulation of appetite, subjective and objective measurements of appetite, and post-exercise energy intake. We then discuss the impact of exercise intensity, sex,

and exercise training (e.g., beginning a fitness program) on appetite. Although extensive research has investigated the role of exercise on appetite and/or energy intake post-exercise in exercise-trained men, there is a lack of consensus and limited data for exercise-trained women. The impact of exercise on subsequent energy intake and whether exercise-trained individuals totally compensate for energy expended during exercise is also reviewed. Next the impact that low-ED diets have on appetite and energy intake is discussed. Finally, the limited research on the combined effects of high-intensity exercise and low-ED diets is examined. This research has been done in exercise-trained women who are often concerned with weight and body image and may select low-ED foods to keep energy intakes low. Unfortunately, the resulting low-energy intakes can have negative health consequences when combined with high levels of exercise. More research is needed examining the combined effect of diet and exercise on appetite regulation in exercise-trained individuals.

**Results**

Exercise is an important part of a healthy lifestyle. In addition to directly increasing energy expenditure, exercise may also influence appetite and energy intake. Recent studies have shown that an acute bout of exercise has the capacity to alter circulating appetite-regulating hormone concentrations. Further, exercise intensity may also influence the degree of appetite suppression. HIE has been shown to lead to greater appetite suppression than low- or moderate-intensity exercise. However, most research, examining the effect of exercise on appetite and appetite-regulating hormones, has been done in exercise- trained males. Thus, the impact of exercise on appetite in exercise-trained, normal- or lean-weight women is limited. Female athletes who participate in sport are often concerned about body aesthetics and weight, thus, understanding the influence of exercise and diet on appetite and overall energy balance is important. Diet can also influence appetite and subsequent energy intake. When HEI exercise in combined with a low-ED diet, total energy intake may be further decreased. Although, consuming a low-ED diet has many health benefits, for some highly exercise-trained individuals, this eating pattern may not provide enough energy and nutrients during periods of heavy exercise training. In this population, a low-ED diet can lead to chronically low-energy intake and increased risk for negative health consequences. More research is needed, especially in active women, examining the combined effect of diet and exercise on appetite regulation in active individuals.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 724 | Healthy Lifestyle |
| 901 | Program and Project Design, and Statistics |
| 903 | Communication, Education, and Information Delivery |

**Outcome #5**

**1. Outcome Measures**

Improved nutrition * schools offer/encourage healthful foods * more effective programs and student experiences * markers and strategies become the standards of methods and measurement of childhood overweight and resiliency

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
American Indians as a whole have one of the highest rates of obesity and diabetes in the United States. Exacerbating this deadly problem is that many Indian reservations have been designated a food desert due to a lack of grocery stores, farmers' markets, and healthy food providers within a reasonable distance from their homes. The Warm Springs Reservation has been designated a food desert. In addition, approximately 24 percent of American Indians in the United States live below the poverty line (U.S. Census Bureau 2011) and Warm Springs is no exception. With above average unemployment and poverty a daily reality, affording healthy food poses a real challenge for tribal members. A solution to this is engaging tribal members in growing their own garden. Studies show that an average size garden can initially save families between $300-$677 dollars per year. This dollar savings is just in the first year, as the longer the garden is in place, the more profitable it becomes as plants become established and increase in productivity.

**What has been done**
The goal was to revive the OSU demonstration garden to full production and train Native Americans in growing their own garden, while providing fruits and vegetables for their families at low cost. With the help of OSU colleagues, we can help increase tribal members knowledge of gardening and healthy eating habits to combat diabetes and obesity rates on the reservation.
In the spring of 2015 a church group donated time for weeding and cleaning up the OSU demonstration garden that had lapsed into disrepair. OSU directed the placement of raised beds, purchased and filled them with garden soil and installed irrigation. Additionally, the program secured a plot and grew additional produce to supplement our OSU garden.

Five gardening classes were taught to a total of 35 students instructed in a variety of vegetable gardening topics. The OSU garden was utilized as a learning lab during our classes for hands on experience and learning activities. Additionally, garden produce was utilized in nutritional classes that taught tribal members different cooking methods for vegetables. At the end of the season, with the help of the ROOTS program students, 114 pounds of fruits and vegetables were harvested. This produce was given away to tribal members with financial needs.

**Results**
This project to revitalize two gardens and train Warm Springs tribal members in gardening has resulted in 35 tribal members learning gardening skills while cultivating interest in gardening and eating healthy foods. As an example, in the "Lunch and Learn" gardening classes, students

reported their knowledge increased from a 3.75 to a 7 (1=no knowledge, 10=very knowledgeable). A total of 114 pounds of fruit and vegetables was harvested from the OSU demonstration garden and the Warm Springs community garden. A majority of this produce was given to tribal members that qualify for the Snap-Ed program. As more tribal members learn gardening skills, it is hoped that a new generation of home gardens will become common place. There are 4,306 tribal members on the reservation. If 25% of these members were to grow their own garden and each garden saved $500 in food costs a $538,250 savings could be accrued. This would be a significant savings to tribal members.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |
| 901 | Program and Project Design, and Statistics |
| 903 | Communication, Education, and Information Delivery |

**Outcome #6**

**1. Outcome Measures**

Identify tactics, strategies and factors that provide families, children, and youth access to healthy foods

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Knowledge Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Among early adolescents (10-14 years), poor diet quality along with physical inactivity can contribute to an increased risk of obesity and associated biomarkers for chronic disease. Approximately one-third of United States (USA) children in this age group are overweight or

obese. Therefore, attention to factors affecting dietary intake as one of the primary contributors to obesity is important.

**What has been done**
The purpose of this research was to describe the influence of parenting practices on eating behaviors in general and when specifically applied to independent eating occasions of early adolescents. This information may be helpful to inform parenting interventions targeting obesity prevention among early adolescents focusing on independent eating occasions.

**Results**
The literature regarding food intake and influence of parenting practices is primarily based on eating occasions in general. This review calls for more research on targeted eating occasions that occur when parents and caregivers are not present. These studies can determine the importance of independent occasions to overall diet quality, prevalence of obesity, and health of early adolescents. Finally, research is also needed that examines the relationships between parent and family socio-demographic factors such as income, race/ethnicity, acculturation, and sex of the parent and early adolescent, and influence of parenting practices on eating behaviors during independent eating occasions.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |
| 903 | Communication, Education, and Information Delivery |

**Outcome #7**

**1. Outcome Measures**

Children practice healthy eating as defined by the current U.S. Dietary Guidelines for Americans (Percent of target audience indicating positive change in measured outcome)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

### 3c. Qualitative Outcome or Impact Statement

**Issue (Who cares and Why)**
Hunger and obesity cost the State of Oregon hundreds of millions of dollars annually in lost productivity and healthcare. In addition, these two concerns negatively affect a child's ability to learn in school. Poor health disproportionately affects low-income populations.

**What has been done**
SNAP-Ed brings together federal, state, and local resources to deliver programs to those enrolled in and eligible for SNAP. Funding is through a US Department of Agriculture, Food and Nutrition Service grant program. Effective approaches include:
Focus on obesity prevention.
Requirement of programs to be evidence- based and outcome driven.
Support and collaboration with related state and national initiatives.
Application of the social ecological framework.

**Results**
Since 1993, SNAP-Ed has improved the diets, food-related behaviors (such as shopping and food safety practices), and physical activity levels of thousands of Oregonians. In 2015, SNAP-Ed educators reached out to 2,673 adults and 60,685 youth in classes in 35 of the 36 Oregon counties. Millions of impressions occured through social marketing, with educators at community events, through media buys, our website and social media sites, and via materials distributed in classes for children to take home to their family. Programs were delivered in partnership with 293 agencies at 644 sites such as schools, food pantries, Boys and Girls Clubs and churches.

### 4. Associated Knowledge Areas

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |
| 901 | Program and Project Design, and Statistics |
| 903 | Communication, Education, and Information Delivery |

## Outcome #8

### 1. Outcome Measures

Children engage in healthy levels of physical activity as defined by national physical activity guildeines (Percent of target audience indicating positive change in measured outcome)

### 2. Associated Institution Types

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Rural residency presents unique opportunities and challenges for maintaining healthy body weight. Whether and how family environments, practices, and policies contribute to obesity-related behaviors in rural settings is not well defined. This qualitative research described parent perspectives on how and why rural residency influences family nutrition and physical activity habits in the home environment.

**What has been done**
Nine focus groups were conducted among six rural, low-income, Oregon communities. Participants included 36 parents of elementary-age children from 26 families. A semi-structured interview guide was used to elicit perspectives on family eating and activity habits; the influence of family practices, policies, and features of the home environment; and barriers and facilitators to healthy eating and activity opportunities. Focus group transcripts were analyzed using a constant comparative technique to identify themes.

**Results**
Preliminary findings suggest factors such as community availability of produce, home gardens, and not watching TV during mealtime influenced family eating habits whereas weather, adequate play spaces, and screen time practices influenced physical activity. Time was an important factor associated with eating and activity habits. Additional findings are anticipated to reveal perceived conditions associated with nutrition and activity behaviors as related to constructs of Social Cognitive Theory.

Understanding the supports for and barriers to eating healthfully and being physically active, as experienced by rural families, will inform future intervention strategies to promote healthy nutrition and activity environments in rural family homes. Findings may also facilitate efforts to provide consistent opportunities to practice weight-healthy behaviors across community, school, and home environments.

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 704 | Nutrition and Hunger in the Population |

| | |
|---|---|
| 724 | Healthy Lifestyle |
| 802 | Human Development and Family Well-Being |
| 806 | Youth Development |

**Outcome #9**

**1. Outcome Measures**

Increases in positive levels of Knowledge, Attittude, Skills and Aspiration (KASA) outcomes, as per Bennett & Rockwell, 1995, related to goals of reducing obesity (Percent of target audience indicating positive change in measured outcome)

**2. Associated Institution Types**

- 1862 Extension
- 1862 Research

**3a. Outcome Type:**

Change in Action Outcome Measure

**3b. Quantitative Outcome**

| Year | Actual |
|---|---|
| 2015 | 0 |

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

**Issue (Who cares and Why)**
Health and nutrition educators work in community settings implementing healthy lifestyle programs focused on obesity prevention and chronic disease reduction. These lifestyle programs typically emphasize improving diet and PA behaviors, which will result in improvements in health outcomes such as body size and fittness, or reduced chronic disease risk factors. To determine the effectiveness of these programs, nutrition educators must identify and measure outcomes related to their program goals. As part of the overall lifestyle program evaluation, assessing changes in diet, PA, or physical fitness (PF) is frequently done. Although nutrition educators are confident in their ability to assess dietary change, they may be less confident in their ability to select, administer, and interpret PA or PF assessments to measure the impact of a PA intervention. The goal of this work is to help nutrition educators, who are less familiar with exercise science, to identify and select appropriate field-based assessment tools for the measurement of change in PA, PF, and/or body composition.

**What has been done**
Specific guidelines, references, and resources are given for selecting assessment methods and test within these three areas (PA, fitness, and body composition).

**Results**

Nutrition and health educators rely on valid and reliable measurements to assess their community-based programs for effectiveness, areas for enhancement, and data to support sustainability. This overview provides a guide for selecting field-based evaluation tools to estimate PA and PF and measure changes in body composition. In addition, standardizing PA program evaluation measurement techniques allows for comparison between intervention programs and over time.

Lindsay AR, Hongu N, Spears K, Idris R, Dyrek A, Manore MM. Field Assessments for obesity prevention in children and adults: Physical activity, fitness, and body composition. J Nutr Ed Behav. 2014; 46(1):43-53. PMID: 23850013

**4. Associated Knowledge Areas**

| KA Code | Knowledge Area |
|---|---|
| 703 | Nutrition Education and Behavior |
| 724 | Healthy Lifestyle |
| 806 | Youth Development |
| 901 | Program and Project Design, and Statistics |

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

**External factors which affected outcomes**

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

**Brief Explanation**

Among adults, obesity rates are sometimes associated with lower incomes, particularly among women Women with higher incomes tend to have lower BMI, and the opposite is true, those with higher BMI have lower incomes. A study in the early 2000s found that about 38% of non-Hispanic white women who qualified for the Supplemental Nutrition Assistance Program (known then as food stamps), were obese, and about 26% of those above 350% of the poverty line were obese. Also, a recent study of American adults found lower rates of obesity among individuals with more education. Specifically,the study found that nearly 35% of adults with less than a high school degree were obese, compared to 21% of those with a bachelor's degree or higher.
The relationship between income and obesity in children is less consistent than among adult women, and sometimes even points in the opposite direction. Another study from the early 2000s found that only among white girls were higher incomes associated with lower BMI. Among African-American girls, the prevalence of obesity actually increased with higher socioeconomic status, suggesting that efforts to reduce ethnic disparities in obesity must

target factors other than income and education, such as environmental, social, and cultural factors.

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

### Evaluation Results

Obesity is multi-factorial, involving complex interactions between physiological, behavioral, social, and environmental variables. While obesity has been increasing among adults, it is also becoming more prevalent in children. Currently, ~ 32% of children and adolescents aged 2-19 years if age are overweight, while 17% are obese. The increasing number of youth experiencing weight problems is troubling, since it puts them at risk for one or more chronic diseases earlier in life. The project team is applying a social-ecological framework to study how exposure and familiarity with more nutritional foods can increase incorporation of these foods into diets of various populations, as well as increase acceptability. The study is also determining if the greater exposure and familiarity with whole grains, vegetables and fruits increases the selection and incorporation of these foods into typical dietary patterns at home and in school lunches as well as among seniors in residential retirement communities. The project has examined what environmental and social factors predict how groups (e.g. communities, schools, families) and/or individuals (e.g. mothers, family food providers, etc.) make long-term positive changes in dietary patterns, healthy eating and physical activity (PA) behaviors for obesity prevention and reduction of chronic disease risk. Finally, we are determining the impact of diet (types of foods) and levels of PA intensity on appetite, food selection and weight management.

### Key Items of Evaluation

Research is needed to determine strategies to increase taste preference or liking for low energy dense foods, especially vegetables and whole grains. Decreased rates of home meal consumption and cooking, and increased popularity of non-vegetable snacks, sweetened beverages, and processed grains have diminished the incorporation of these healthy foods into our diets. In addition, children's lack of exposure or familiarity with these foods, limited opportunity to gain experience in developing likeness, and an unwillingness to try healthy food options also reduce intake. Encouraging these foods will require increasing awareness of preparation that meets time and cost limitations of families, is culturally acceptable, and that can be readily incorporated into meals and snacks. This includes having healthy foods consumption role modeled within households and among peers, and having access and availability of those foods in the household and at school. Families also live in communities, where the opportunities to be active and grow and select healthy foods are important. Rural communities provide an excellent context in which to examine the fruit and vegetable consumption patterns of youth at risk while also engaging youth in productive work within their own communities. By engaging low-income youth in the construction and maintenance of gardens and in harvesting and marketing organically grown produce, we have found that youth not only consume more produce, but they also become more visible and engaged in their communities. Although youth garden projects initially may not produce enough vegetables to provide a living wage for more than one or two youth, the Producing for the Future Project has found that the increased visibility of the youth participants at the local farmers market can lead to other economic opportunities for youth. Further, mentorship from supportive adults within their own community can encourage youth at risk to stay in school and may even open avenues to higher education. Community youth gardens may be both a strategy for developing collaborations in rural communities while also providing exposure to produce, nutrient dense foods that can serve to prevent the development of overweight and obese in our youth. Familiarity

with the process of growing vegetables potentially increases the consumption of such items. Developing gardens that target low-income youth within communities has the potential to foster supportive adult-youth collaborations that are beneficial for the health of vulnerable residents and the vitality of the community.

# VI. National Outcomes and Indicators

## 1. NIFA Selected Outcomes and Indicators

| | |
|---|---|
| **Childhood Obesity (Outcome 1, Indicator 1.c)** | |
| 0 | Number of children and youth who reported eating more of healthy foods. |
| **Climate Change (Outcome 1, Indicator 4)** | |
| 0 | Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits. |
| **Global Food Security and Hunger (Outcome 1, Indicator 4.a)** | |
| 0 | Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources. |
| **Global Food Security and Hunger (Outcome 2, Indicator 1)** | |
| 0 | Number of new or improved innovations developed for food enterprises. |
| **Food Safety (Outcome 1, Indicator 1)** | |
| 0 | Number of viable technologies developed or modified for the detection and |
| **Sustainable Energy (Outcome 3, Indicator 2)** | |
| 0 | Number of farmers who adopted a dedicated bioenergy crop |
| **Sustainable Energy (Outcome 3, Indicator 4)** | |
| 0 | Tons of feedstocks delivered. |