2017 Oregon State University Combined Research and Extension Annual Report of Accomplishments and Results

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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 2017 year continues its tradition of collaboration across disciplinary and organizational lines. This year, collaborative work has changed as the Station has completed 5 broad collaborative program projects and begun implementing six new research projects to address NIFA program areas. Unfortunately, for the purposes of this report, we continue to have state defined outcomes related to the previous projects as we have not had the ability to update the POW since 2015. Consequently, most outcomes are those associated with the old projects and unrelated to our current efforts.

Funding

One of the Experiment Station's state performance metrics is external funds leveraged per dollar of state funding. In 2016-2017, $31 million in state appropriations were leveraged by faculty to generate $90 million in external fund expenditures, yielding a metric of nearly 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, Food Energy Water Nexus, Climate Change, Global Food Security, Food Safety, and Obesity. The following are highlights from these Planned Programs.

Food Energy Water Nexus

Water shortage and nitrate pollution is mostly attributed to irrigated agriculture. Our long-term goals are to restore 12,300 ha-m of water supply and reduce nitrate in groundwater to < 10 mg $L^{-1.}$ We will be utilizing Hatch and state matching funds to support OSU CAS scientists dedicated to solving water, food, and natural resources problems in Umatilla Basin to reach these goals. Through integrated research, education, extension, and outreach activities, the projct will address systemic challenges to improving water quality and access to water for food production and ecosystem health. In this phase, we will characterize basin hydrology and ecosystem health, and determine source and extent of nitrate pollution. We will apply models to begin formulation of best management practices based on this information. This proposal is submitted in response to Oregon DEQ's declaration of CGA and GWMA in the Umatilla Basin.

Climate Change

The collaborative project addressing this program area has been completed. Research continues to evaluate new crop varieties that will perform well in a warmer and drier climate. Additionally, improving water use efficiency to reduce consumption and reuse of process water and waste water streams to

improve quality of shallow aquifers remains an important focus in this area.

Decision making tools that allow producers to better evaluate planting, cropping, and harvesting strategies for both conventional crops and new crops continues to be a focus of much research and outreach activities.

Faculty 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 maintain and expand the nutrition of populations. 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 food conservation 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 in several 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 better understanding of the mechanisms of pathogenesis of many virulent bacteria and viruses.

Creating more resilient crops, including specialty crops is another focus of this research and outreach. A changing climate can accelerate virulence of existing pathogens or allow for the expansion of previously undocumented pathogens. Similarly, introduction of invasive species or inadvertent introduction of new insects can all threaten global food security. Finally, we have focused on training a new cadre of agricultural scientists that recognizes the importance of diversity and inclusion to ensure that all people across the globe have access to a secure food supply.

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 and unique 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.

OSU researchers and extension faculty are actively engaged in efforts to reduce the prevalence of herbicides and pesticides through application of IPM. Faculty members are also seeking new ways to improve food safety from the time the food is harvested until it is delivered to the table. This includes new processing and handling techniques as well as new packaging, storage, and food preparation applications.

Childhood Obesity

Research efforts have lessened during the reporting period due primarily to faculty retirements and transitioning from research to dissemination of findings through outreach and engagement. The project team will apply 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 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.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	193.0	0.0	215.0	0.0
Actual	180.3	0.0	405.0	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. Multi-state project reviews follow the NIFA prescribed process through the Advisory Committee and WAAESD.

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
- Other (cspan)

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.
Reviews of unit leaders and faculty are conducted periodically to assure that personnel are responding appropriately to relevant stakeholders, industry, and consumers.

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,)

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. Every branch station enlists stakeholders to serve as an advisory council for station work planning and research emphasis.

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

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.
Social media via Twitter, Facebook, and hosted web pages also provide a venue for soliciting input and gauging reactions to Station announcements, programs, and published articles. Gathering data on the number of visits and the demographics of those visitors provides valuable insight into stakeholder interest and emerging issues.
Beginning in 2018, the University will begin a new strategic planning exercise and capital campaign that will provide valuable input from stakeholders

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
- Other (Strategic Intent)

Brief explanation.

Stakeholder input was used to adapt our curriculum with more experiential learning and incorporation of more agribusiness courses as part of the core. We have also begun to focus more effort on AI and machine learning to address the ongoing labor shortages associated with new immigration policies. Finally, we have adopted more writing intensive courses to improve graduate proficiency in communication of work efforts in their professional fields.

Brief Explanation of what you learned from your Stakeholders

Producers are becoming increasingly aware of the impact trade policies have on agriculture. As developing countries have expanded their middle classes, their is increased global demand for US specialty crops and organic crops. Too often, producers suffer the consequences of reduced international demand because foreign trade policy ignores the impact on agriculture.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1285108	0	3897939	0
Actual Matching	1285108	0	38370166	0
Actual All Other	4136473	0	41129848	0
Total Actual Expended	6706689	0	83397953	0

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	0	0	0	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
102	Soil, Plant, Water, Nutrient Relationships	0%		5%	
111	Conservation and Efficient Use of Water	0%		15%	
112	Watershed Protection and Management	0%		15%	
125	Agroforestry	10%		5%	
131	Alternative Uses of Land	0%		5%	
132	Weather and Climate	0%		5%	
133	Pollution Prevention and Mitigation	0%		5%	
402	Engineering Systems and Equipment	0%		5%	
403	Waste Disposal, Recycling, and Reuse	40%		10%	
511	New and Improved Non-Food Products and Processes	0%		5%	
601	Economics of Agricultural Production and Farm Management	20%		5%	
608	Community Resource Planning and Development	20%		10%	
609	Economic Theory and Methods	0%		5%	
903	Communication, Education, and Information Delivery	10%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	6.0	0.0	4.0	0.0
Actual Paid	2.0	0.0	1.4	0.0
Actual Volunteer	30.0	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**
38553	0	351022	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
38553	0	3459842	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
124094	0	1493129	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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	19392	8593	6279	236

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	5	7	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Develop greater understanding of the factors that contribute to resilience to economic and climatic perturbations at regional and farm level. We will study resilience at regional scale using integrated models and evaluate the potential of agri-voltaic systems to promote resilience at individual farm scale.
  Not reporting on this Output for this Annual Report

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	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)
4	Increased knowledge regarding the use of agricultural crops for energy production (percent increase in knowledge of attendees to workshops, field days and demonstrations)
5	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,
6	Increased knowledge regarding the use of forest biomass as an energy source (Percentage increase in knowledge of attendees to workshops, field days, and demonstrations)
7	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.
8	Biodiesel production from camelina 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 dairy waste water as a nutrient source willbe performed. Algae will be used to capture nutrients such as nitrogen and phosphorus and the dried algae biomass will be evaluated as a replacement for peat.
9	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
10	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

11	Water, energy and food are inextricably linked. Water is an input for producing agricultural goods in the fields and along the entire agro-food supply chain. Energy is required to produce and distribute water and food: to pump water from groundwater or surface water sources, to power tractors and irrigation machinery, and to process and transport agricultural goods. Agriculture is currently the largest user of water at the global level, accounting for 70% of total withdrawal. The food production and supply chain accounts for about 30% of total global energy consumption. There are many synergies and trade-offs between water and energy use and food production. Using water to irrigate crops might promote food production but it can also reduce river flows and hydropower potential. Growing bioenergy crops under irrigated agriculture can increase overall water withdrawals and jeopardize food security. Converting surface irrigation into high efficiency pressurized irrigation may save water but may also result in higher energy use. Recognizing these synergies and balancing these trade-offs is central to jointly ensuring water, energy and food security.

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The bioenergy research and education priorities being addressed by the SGP have been developed from the bioenergy priorities identified by the Administration and USDA in recent White House announcements and USDA reports. The Western Regional Center also funds initiatives targeting crop suitability mapping, agricultural operations energy assessments and efficiencies, and
developing specialty biochar for soil enhancement and bioenergy

What has been done
Researchers at the Desert Research Institute have fully developed a method for characterizing a syngas (from a gasifier) with a gas chromatograph-thermal conductivity detector (GC-TCD). The method will quantify hydrogen, carbon monoxide, carbon dioxide, and methane."

Ohio University researchers performed a kinetics study on pyrolysis and CO2 gasification of manure-derived hydrochar. The activation energies, pre-exponential factors, and the change of percent yield with respect to temperature were determined. They also received a small downdraft gasifier and prepared a detailed standard operating procedure for it."

Results
Recent MD trials have focused on the treatment of single component aqueous solutions, namely short-chain organic acids. Trends observed with these simple organic acid tests were similar to those observed with hydrothermal aqueous product (HAP), namely a decrease in pH in the distillate over time, indicating passage of the small acids across the membrane. For example, it was found that when treating a feed solution of acetic acid initially at pH 3, the feed side of the MD system increased to pH = 5 while the distillate decreased from pH = 7 to pH = 5 over the same period. The team plans to test dairy manure-derived HAP next. Two domestic companies have contacted the team about commercializing their process, and one has begun negotiating for terms to license the technology."

4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry
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
609	Economic Theory and Methods
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Natural rubber, derived from the Brazilian rubber tree, is essential for manufacturing a wide array of industrial products. The United States depends on imports for the more than $6 billion worth of raw natural rubber it uses annually.

What has been done
Dr. Richard Roseberg and his colleagues addressed Russian dandelion (TKS) crop production issues in an effort to optimize rubber and inulin production. They coupled evaluation of promising methods and seed treatments with field tests using transplants. Working with cooperators at Ohio State University and the Ontario, Canada, Ministry of Food and Agriculture, their initial work revealed that conditions found to be key to good germination--maintenance of consistent moisture near shallow-planted seeds--are difficult to achieve in the field. Steady progress toward resolution of germination and weed control issues led to use of improved methods, but has not yet lowered risk sufficiently for commercial production. Nonetheless, rubber extracted from TKS in this project has been shown to be good quality and suitable for high-value applications, so interest in this potential crop, particularly from the media and tire companies, remains high. This team's resu"

Results
This team's results were used as the basis of a small (non-Sun "Grant) Oregon 2016 field study to test many of the same factors. Results to date suggest that high densities will increase total biomass and presumably total rubber yield; higher density plantings compete better with weeds; and optimal harvest time varies depending on which end-product is of greatest interest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry
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

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)

Not Reporting on this Outcome Measure

Outcome #4

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)

Not Reporting on this Outcome Measure

Outcome #5

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
125	Agroforestry
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
609	Economic Theory and Methods
903	Communication, Education, and Information Delivery

Outcome #6

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Researchers are evaluating the potential of Western Juniper removal and torrefaction of the biomass as a way to improve rangeland restoration. Western Juniper now occupies nearly 10MM acres of what was once prime rangeland and habitat for many threatened species including the greater sage grouse.

What has been done

Juniper was removed from several plots in Wheeler County, OR and torrefied on site. Post removal, the sites were treated with the biochar made from juniper in order to encourage reestablishment of native forbs and grasses.

Results
Results will be available next year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
125	Agroforestry
403	Waste Disposal, Recycling, and Reuse
608	Community Resource Planning and Development
903	Communication, Education, and Information Delivery

Outcome #7

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.

Not Reporting on this Outcome Measure

Outcome #8

1. Outcome Measures

Biodiesel production from camelina 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 dairy waste water as a nutrient source willbe performed. Algae will be used to capture nutrients such as nitrogen and phosphorus and the dried algae biomass will be evaluated as a replacement for peat.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
131	Alternative Uses of Land
132	Weather and Climate
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
609	Economic Theory and Methods
903	Communication, Education, and Information Delivery

Outcome #9

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

Not Reporting on this Outcome Measure

Outcome #10

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 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project integrates three areas of analysis to address biofuel production, which may be a key issue in sustaining the agriculture components of profitability, renewable energy, and rural communities. Sustainable development of bioenergy systems is a complex issue which involves multiple disciplines including environmental/ biological, engineering, and economic and policy analysis at the local, state, and regional levels. We develop a unique, robust framework of analysis to accelerate the achievement of the four long term goals set out by the National Research Council Committee on Twenty-First Century Systems Agriculture: satisfy human food, feed, and fiber needs and contribute to biofuel needs; enhance environmental quality and the resource base; sustain the economic viability of agriculture; and enhance the quality of life for farmers, farm
workers, and society as a whole.

What has been done
Adoption rates and economic impact obtained from the TOA-MD model for low ($0.1), medium ($0.15 and $0.225) and high ($0.30) Camelina prices per pound. Average Treatment Effect (ATE): average impact of the WWC system relative to the WWF System if it were adopted by all farms. Average Treatment Effect on the Treated (ATT): Economic impact on the adopters; difference between the returns from the WWC System for the adopters and the returns the adopters would receive from the WWF System if they did not adopt (the counterfactual returns). Average returns to all farms of this system are negative/low unless the Camelina prices is quite high. For those who do adopt, the return is necessarily positive as indicated by the ATT, and increasing with the Camelina price, even when the ATE is negative. Relatively elastic response to prices above $0.20, with this response being affected also by the wheat price, with higher wheat prices discouraging WWC adoption. Impact on wheat production would be relatively small. Wider adoption throughout the United States could have a more substantial impact.

Results
A new computable general equilibrium (CGE) economic model was developed that simultaneously accounts for a number of economic sectors that are key to the analysis. Parameters of the model were calibrated primarily using highly detailed IMPLAN data for the Pacific Northwest region. It was determined that a suitably motivated government could conceivably take the estimates of this study and use them to guide policies that would facilitate the emergence of an aviation
biofuel supply chain in the Pacific Northwest.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
131	Alternative Uses of Land
403	Waste Disposal, Recycling, and Reuse
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
609	Economic Theory and Methods
903	Communication, Education, and Information Delivery

Outcome #11

1. Outcome Measures

Water, energy and food are inextricably linked. Water is an input for producing agricultural goods in the fields and along the entire agro-food supply chain. Energy is required to produce and distribute water and food: to pump water from groundwater or surface water sources, to power tractors and irrigation machinery, and to process and transport agricultural goods. Agriculture is currently the largest user of water at the global level, accounting for 70% of total withdrawal. The food production and supply chain accounts for about 30% of total global energy consumption. There are many synergies and trade-offs between water and energy use and food production. Using water to irrigate crops might promote food production but it can also reduce river flows and hydropower potential.

Growing bioenergy crops under irrigated agriculture can increase overall water withdrawals and jeopardize food security. Converting surface irrigation into high efficiency pressurized irrigation may save water but may also result in higher energy use. Recognizing these synergies and balancing these trade-offs is central to jointly ensuring water, energy and food security.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The effect of regional factors on life cycle assessment (LCA) of camelina seed production and camelina methyl ester production was assessed in this study. The results showed that GHG emissions during camelina production in different regions vary between 49.39 to 472.51 kg CO2-eq./ha due to differences in agro-climatic and weather variations. The GHG emissions for 1 kg of camelina produced in Corvallis, Pendleton, Pullman, and Sheridan were 0.76±11%, 0.55±10%, 0.47±18% and 1.26±6% kg CO2-eq., respectively. The GHG emissions for 1000 MJ of camelina biodiesel using camelina produced in Corvallis, Pendleton, Pullman, and Sheridan were 53.60±5%, 48.87±5%, 44.33±7% and 78.88±4% kg CO2-eq., respectively.

What has been done
We conducted a regional scale LCA using the soil emissions and soil organic carbon modeled in DNDC and openLCA software. Uncertainty analysis was carried out using Monte Carlo method, and the results showed that there could be up to 23% variation in soil emissions due to variation in air
temperature and SOC. The break-even cost for a three-year crop rotation (winter wheat-fallow-camelina) was estimated to be 1715 $/ha/3years; therefore, locations with income equal or more than the break-even cost and low environmental impacts are suitable for the winter wheat-fallow-camelina rotation system.

Results
We integrated a crop model, DNDC (DeNitrification-DeComposition), with life cycle assessment (LCA) and economic analysis models using a GIS-based integrated platform, ENVISION. The integrated model enables LCA practitioners to conduct integrated economic analysis and LCA on a regional scale while capturing the variability of soil emissions due to variation in regional factors during production of crops and biofuel feedstocks.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
131	Alternative Uses of Land
132	Weather and Climate
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
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

Bioenergy research funding continues to decline as the ability for advanced biofuels to compete with low cost fossil fuels continues to erode investment and interest. This has led to an increased focus on the production of intermediate chemicals as the principal output with biofuels being relegated to a secondary role. Advances in other sectors including fuel cells, novel pre-treatment processes, logistics, and economics have stalled as well, as private investment and federal investment has been reduced.Efforts continue to pursue innovative uses of biomass for biopower in conventional fossil fuel plants through both pyrolysis and torrefaction. The advantage of this approach is the production of biochar as a byproduct of the conversion process that can then be used as a soil amendment in depleted soils or as an amendment for rangeland restoration and improvements.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

We have made significant progress evaluating the limitations of biomass (particularly forest residues) due to logistical concerns. Mobile refineries couple with fixed refineries can address many of these issues although the spatial arrangement of the refineries with respect to the source of biomass remains to be optimized. Transportation infrastructure and transportation equipment will need to be improved to make these products cost

competitive with fossil fuel sources.
Fuel cells represent an excellent opportunity for treating wastewater from any number of industrial, agricultural, and municipal sources. These fuel cells can make the water available for other uses and provide decentralized energy production. Several patents have been issued to researchers at OSU currently working closely with the brewing industry to treat brewery effluent.

Key Items of Evaluation

Significant cost barriers continue to constrain the use of biomass for bioenergy production. This is particularly true for the "up stream" costs of harvesting, aggregating, transporting and storing biomass prior to pre-treatment at the refinery. Mobile refineries may show promise under precise scenarios designed around fixed refineries and location of the biomass.
A new biorefinery that utilizes beetle killed pine is set to begin construction this year with completion scheduled for 2019. This facility will provide a unique opportunity for our researchers to study optimization of harvesting, aggregation, and transport of woody biomass.

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	5%		5%	
102	Soil, Plant, Water, Nutrient Relationships	8%		5%	
103	Management of Saline and Sodic Soils and Salinity	4%		5%	
112	Watershed Protection and Management	8%		5%	
121	Management of Range Resources	5%		0%	
122	Management and Control of Forest and Range Fires	5%		0%	
123	Management and Sustainability of Forest Resources	5%		5%	
125	Agroforestry	5%		5%	
135	Aquatic and Terrestrial Wildlife	5%		5%	
136	Conservation of Biological Diversity	5%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	8%		5%	
212	Pathogens and Nematodes Affecting Plants	5%		5%	
215	Biological Control of Pests Affecting Plants	5%		5%	
302	Nutrient Utilization in Animals	4%		0%	
303	Genetic Improvement of Animals	5%		5%	
311	Animal Diseases	4%		5%	
604	Marketing and Distribution Practices	4%		5%	
605	Natural Resource and Environmental Economics	5%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	0%		5%	
723	Hazards to Human Health and Safety	5%		15%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	50.0	0.0
Actual Paid	2.0	0.0	3.9	0.0
Actual Volunteer	139.0	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
38553	0	906981	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
38553	0	8939647	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
124094	0	9142596	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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2812	395	1500	1340

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	35	19	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Performance of Regional Climate Hubs
  Not reporting on this Output for this Annual Report

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	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.
8	Participants who increase their knowledge of management practices and understanding of climate variability and change (Percentage).
9	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).
10	Clients who employ climate adaptation strategies or incorporate climate-based management practices (Percentage).
11	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
12	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).
13	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.

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the USDA Economic Research Services, agriculture is the biggest user of water in the United States, accounting for approximately 80% of the Nations consumptive water use and over 90% in many Western States. Demand for water in the inland Northwest is increasing due to population growth, environmental issues concerning salmon and climate change. Finding ways to reduce the need for water in agriculture should be a priority on an international level. One has only to look to neighboring California to see the impact of the most recent drought on their agricultural industries where researchers from the UC Davis Center for Watershed Sciences estimated that it cost an estimated $2.7 billion and 21,000 jobs were lost.

What has been done
Produced a cuticle supplement that is > 90 um thick. The product is now known as HydroShield. Also looked at individual ingredient properties to determine whether they are attractive or repellants for Spotted Wing Drosophila.

Results
This reduces water usage without affecting plant yield in apples, sweet cherries and wine grapes. Soil moisture has not been adversely affected by reducing water usage by 25% in conjunction with HydroShield. Fruit size of 'Gala' has been increased by 6%. Fruit cracking of 'Utah Giant' cherries was reduced by 19%. Berry size of wine grapes was smaller in the HydroShield plus 50% reduction resulting in better quality grapes with ~1% higher TSS (sugar) than the check.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
302	Nutrient Utilization in Animals
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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project works to establish a partnership between Extension, local researchers at the HJ Andrews Long-term Ecological Research program and PRISM, to develop collaborative climate change-related research and educational activities to the mutual benefit of Extension and HJA

What has been done
In 2017 we converted OST to a hybrid class structure, with on-line introductions to the OST program and our two national partners and their reporting platforms Community Collaborative Rain Hail & Snow Network (CoCoRaHS) and National Phenology Networks' (PPN) Nature?s Notebook. Trainees then participate in a face to face session for team building and skills development, received their rain gauges and started observations as an OST volunteer. We are developing strategies to accommodate people in more remote areas as well.

We offered 8 local trainings in 2017 (4 in the mid valley area, and one each in four other counties: Lane, Tillamook, Multnomah and Klamath for a total of 79 individual participants trained, including many couple teams taking on the project at their home site. We also continued to work with teachers in 6 schools in the OST 4-H classroom program.

Results
We have trained 277 OST volunteers to date (from 2014 to 2017). This has led to 139 unique registered rain gauge stations tracking precipitation with the OST program and the CoCoRaHS national database. We work with the National Phenology Network (NPN) to track plant phenology observations through their Nature?s Notebook (NN) system. We show 9,025 unique phenology observations in 2017, and 28,720 total observations contributed by OST affiliated observers from

the start of the OST program in 2014.

In a 2015 evaluation, 100% of responses reported improved understanding of variation in precipitation and plant phenological processes across both landscapes and time. 95% of responses agreed or strongly agreed that OST program contribute to a better scientific understanding of climate and weather. The survey also tells us something about people?s motivations. We found participants are interested in the scientific effort, in contributing to local knowledge and want to generate information that will be used by the scientific community. This fits with the project?s objective of continued learning and engagement of Citizen Science volunteers with the research community.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
311	Animal Diseases
604	Marketing and Distribution Practices
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
There is increasing interest among producers and consumers in farming practices that reduce greenhouse gas emissions and increase carbon sequestration (i.e. Climate Friendly Nurseries Project). Manufacture and use of synthetic fertilizer represents about 29% of agricultural energy use (CRS Report for Congress). In this context researchers are interested in helping growers optimize fertilizer use efficiency. Non-fertilizer N sources provide an opportunity to reduce application rates, but are difficult to quantify. We are working in partnership with West Multnomah Soil and Water Conservation District, Multnomah County NRCS and area farmers to enhance non-fertilizer N and improve our ability to quantify these sources when making fertilizer decisions. We are also demonstrating the use of cover crops in their commercial vegetable rotations.

What has been done
With contract support from West Multnomah SWCD we are monitoring soil nitrate levels in annual and perennial crops. We are incubating soil samples to estimate N release from soil organic matter and helping growers adapt cover crops to their farming systems. During the project we have collaborated with eleven growers and monitored nitrate levels in more than 90 fields. We have conducted fertilizer rate demonstration trials in 31 fields and various cover crop species have been demonstrated in 16 fields. Cover crops have been planted into bare soil after harvest and relay seeded into late harvested vegetables.

Results
Initial results indicate a 60% reduction in nitrogen application. Further results will be reported next year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
121	Management of Range Resources
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
604	Marketing and Distribution Practices
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
About 16,000 family forest owners in Oregon?s northern Willamette Valley counties manage 700,000 acres of private forestland, providing substantial economic, social, and ecological values. A needs assessment in 2016 showed that landowner goals are very diverse, as are the challenges they face in achieving success in their forest stewardship. Providing landowners with opportunities to learn what they need to know to solve problems or to find the help they need is a high priority for OSU Extension.

What has been done
The 27th annual Tree School (2017) provided 74 classes for 625 woodland owners, involving 80 instructors and over 100 supporters and volunteers. Classes address the diversity of perspectives and needs amongst woodland owners along with the diversity of forest conditions from bare ground to mature forest. It is the major regional event providing a foundation for successful management of private woodlands in NW Oregon. Tree School has an annual budget of about $48,000, funded by supporters and registration fees.

Results
To assess the impact of Tree School, we emailed a Qualtrics survey to 1360 Tree School participants from 2012-2017 and received 319 responses.

Tree School is an effective and high-quality education program. Most people attending Tree

School are repeat customers (80%), with over half (55%) attending 4 or more times. Compared to other education opportunities, 88% rated Tree School as the best (20%) or among the best (68%) in their experience.

Most respondents (92%) said they improved on-the-ground management as a result of Tree School. Respondents said they were better able to: increase productivity of timber (74%); increase survival of planted trees (69%); operate equipment safely (64%); control weeds (56%), create wildlife habitat (56%), and manage forest health (53%).

Tree School is having a significant impact on landowner success in stewardship. As a result of information received at Tree School, respondents estimated:

931,500 Trees Planted
2,250 acres of forest thinned
14.2 million board feet harvested
14 miles of streamside managed

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
121	Management of Range Resources
123	Management and Sustainability of Forest Resources
125	Agroforestry
135	Aquatic and Terrestrial Wildlife
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Native pollinator populations in Oregon are threatened by loss of habitat, disease, parasites, and incidental pesticide exposure. Native bees are valuable crop pollinators in the Willamette Valley and serve as substitute pollinators when honeybees are scarce. The West Multnomah Soil & Water Conservation District (WMSWCD) designs and installs native pollinator habitat on private land in the Portland metro area to support native bee populations. WMSWCD is interested to know if their habitat projects attract more pollinators and/or more diverse pollinator communities, but they lack the staff to monitor and evaluate the efficacy of the habitat projects.

What has been done
The Master Naturalist Program developed a pollinator monitoring partnership with WMSWCD. WMSWCD and The Xerces Society trained 20 volunteers (including 6 Master Naturalists) how to identify native bee species and follow a habitat project monitoring protocol. I recruited and coordinated the volunteers, assisted with the classroom training, led the field training for each monitoring team, developed training materials, and organized the data sets for delivery to WMSWCD. Training began in April 2017 with a monitoring season of April through September 2017. The next training will take place in April 2018 with a monitoring season of April through September 2018

Results
Although it is too early to judge which specific habitat features contributed most to pollinator numbers and diversity at the trial sites, this data has proven useful in establishing what the baseline populations are. With additional years of data, we will be able to understand more about habitat features that attract an abundant and diverse group of native pollinators.

Perhaps more interesting were the interactions among the volunteers involved in this project. Twenty individuals took the training and applied the protocols at 33 sites to deliver high-quality data. Volunteers reported that they were surprised by what they learned about scientific research: regular field observations take priority over the weather and other obligations; you may not see what you had hoped to see in the field; reporting zero pollinators at a site is valuable information even if it seems uninteresting; research takes time and dedication, etc. At the end of season celebration, they exchanged information about their unique experiences at each site, including which plants seemed to be best at attracting different pollinator species as various times of year. Several volunteers indicated that it was a great experience in seeing how science actually works and they look forward to participating again next year.

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
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
2017	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, increased temperatures, and drought leading to reductions in summer water availability. In the 2015 drought some growers with junior water rights had their irrigation restricted as early as June. In addition, many new farmers have trouble finding and accessing land with unrestricted irrigation rights. Therefore, it is essential to 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 growing with little or no irrigation.

What has been done
In response to these escalating concerns, OSU Small Farms Program launched the Dry Farming Project in 2013. The project started small, but has had a growing impact over the past three years, leading to the establishment of the Dry Farming Collaborative (DFC). The DFC began with a few growers in the Willamette Valley that has grown into a regional project attracting national

and even international interest and engagement. Dry farming is an alternative to irrigated crop production in the maritime Pacific Northwest, on sites where deep soils have good water holding capacity. Dry farming optimizes residual moisture stored in soils, and usually occurs in regions that receive 20 inches or more of annual rainfall.

Results
Ninety-three percent of survey respondents who attended the 2015 field day reported that they intended to apply what they learned, and intended to experiment with dry farming on their land. Of these respondents only half were on land without water rights or limited water availability. The other half were interested in dry farming for other reasons including: conserving water, sustainability in climate change, and improved flavor and storage of produce.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

Outcome #7

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Native Americans may be highly vulnerable to climate change because they rely heavily on ecosystem services, including traditional foods, hunting, timber production, non-timber forest resources, ranching quality, agricultural suitability, and cultural resources. Native Americans are also culturally tied to the historical landscape and recognize many places that are sacred and outside tribal reservation boundaries. Tribal lands may consist of not only tribal reservations, but also ceded lands, treaty areas, and lands used for traditional food, medicine, and spiritual purposes. Climate change is already affecting vegetation and has led to significant changes in species composition, phenology, biotic interactions, and disturbance regimes. Managing ecosystems and ecosystem services requires an understanding of these impacts.

What has been done
Tribal members from Washington and Oregon collaborated with researchers from the PNW Research Station in the exchange of climate change information through a workshop. The workshop will reflected on tribal knowledge when possible, and identified possible adaptation responses and opportunities. Janean Creighton from the Northwest Fire Science Consortium collaborated on publicizing, scheduling and conducting the workshop.

Results
Researchers from the PNW Station presented results from the research team assessment that identified potential climatic changes to vegetation, fire, and ecosystem services across tribal lands and sacred places throughout the Pacific Northwest, and interactively identified relevant adaptation strategies and tactics through a hands-on activity with session participants.
With the use of needs assessment maps, participants gained a better understanding of future vegetation change. Using the presented information together with participant expertise and knowledge clear linkages were made as to how these changes may impact important ecosystem services, such as traditional foods, hunting, timber production, non-timber forest resources, ranching quality, agricultural suitability, and cultural resources. Participants were provided with spatial data, a tangible list of relevant actionable adaptation strategies, and potential collaboration opportunities with similarly interested individuals.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
121	Management of Range Resources
125	Agroforestry

135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
215	Biological Control of Pests Affecting Plants
302	Nutrient Utilization in Animals
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics

Outcome #8

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

One area of focus that has provided an opportunity to serve the public and the green industry, and involve the Research Faculty at OSU, Master Gardeners and the nursery industry over the last 14 years has been the development of several plant evaluations at the North Willamette Research and Extension Center (NWREC) and at the Oregon Garden. The original goal of these evaluations was to research the hardiness of Hebe, a genus of flowering shrubs native to New Zealand which are very popular and showy, but which in many cases lack sufficient cold hardiness for landscape use in western Oregon. The over-riding goal of all subsequent trials has been to develop fully drought-tolerant, hardy shrubs, especially groundcovers, for use in "low-input" Northwest landscapes. Development of genuinely low-input landscapes for western Oregon will require use of drought-tolerant, evergreen groundcovers, few of which are currently used in local landscapes because data on their adaptability to local conditions are not available. As a result, landscapers tend not to request these plants and nurseries do not grow them in the absence of these data. Instead, better known but poorly adapted species are used which tend not to thrive without significant inputs of water, fertilizer, pesticides and labor. Local evaluations of drought-tolerant, evergreen groundcovers would provide gardeners and landscapers with data on plant adaptability to this region and provide nurseries with access to plants for propagation.

What has been done

In this program researchers led the evaluation of cultivars and species of Hebe (2000-2009), Cistus and Halimium (2004-2009), Ceanothus (2001-2005), and Grevillea (2011-2014) to determine plant growth, hardiness and overall quality in western Oregon. In each case, cooperators, domestic and international, provided plant material which was propagated, grown on and planted out at NWREC for evaluation in the field. Data on each plant group are acquired over several years and included plant size, flowering and overall landscape worthiness, as well as cold hardiness ratings. A similar evaluation of Arctostaphylos was planted out in 2011 and data collection continues on those.

A new evaluation of broadleaved evergreen groundcovers was undertaken in 2017 including an expedition to France to collect drought-tolerant plants at Olivier Filippi's nursery, Pepiniere Filippi, in Meze. The initial planting in this evaluation will take place in 2018.

Results

Specific cultivars of these genera identified in these evaluations have been utilized with suitable companion plants in a variety of un-irrigated landscape projects around Marion and Polk Counties. We have installed landscapes at the St. Francis Shelter in Salem (2007), the Oregon Garden in Silverton (2007), the Willamette Valley Humane Society in Salem (2008), Rotary Park in the City of Dallas (2008) and most recently in several sites in collaboration with the City of Monmouth, including Madrona Park in September 2017 and the OSU Linn County Extension office in November 2017

One of the specific goals of the program is to introduce new cultivars into the nursery trade at both the retail and wholesale level in order to encourage landscape use of the plants. As of 2010, 7 retail and 8 wholesale nurseries in Oregon, Washington and California have taken cuttings from these evaluations to date and are known to be growing and marketing these cultivars. The nurseries are each growing and selling an average of 11 Hebe cultivars, 14 Cistus and 4 Halimium, specifically derived from the evaluation trials. A nursery (Xera Plants, Sherwood, OR) named and is selling a Grevillea selected from one of my trials as a new cultivar ?Neil Bell?.

The most recent evaluation is Arctostaphylos and cuttings have been shared with 4 wholesale and 2 retail nurseries in the Valley in 2017.

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
136	Conservation of Biological Diversity

201	Plant Genome, Genetics, and Genetic Mechanisms
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics

Outcome #9

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New and existing growers require information on production systems that increase yield and quality and promote economic sustainability in this long-lived crop. Information was needed on optimal planting systems, pruning, fertilization, use of organic amendments, machine and hand harvest efficiency, cultivar adaptation, and fruit quality. Organic production systems are covered separately.

What has been done
Approach. Research was conducted on: pruning and cropping of young blueberry plants; pruning severity and impacts on costs, yield, and quality of mature plants; planting density and impacts on long-term production; trellising for machine harvest efficiency; long-term impacts of organic amendments and mulching on plant and soil health and N fertilization rate on yield and quality; carbon sequestration in a mature blueberry field; impact of seed number on berry weight among cultivars; relationship between fruit developmental rate and growing degree days; yield progression and fruit quality of new blueberry cultivars; and irrigation and fertigation practices.

Results
Outcomes and impact. In blueberries, prior to the research and extension programs conducted, ALL blueberry fields were planted at 4 ft. apart in the row. After conducting research on high-density plantings (completed in 2003-2004), ALL new plantings were/are established at 2.5-3 ft. in the row, thus increasing yield with an estimated annual impact of $3 million. In addition, no

blueberries were trellised in Oregon (or elsewhere) prior to my research where trellising was shown to increase machine-harvest efficiency by up to 8% of total yield or one additional ton/acre. Now over 90% of all blueberry plantings are trellised with an estimated annual impact of $5 million/year. New impact from this research has been documented as growers can more easily manage spotted wing drosophila (SWD) through pesticide applications and have less loss of fruit when applying pesticides during the fruiting season in trellised fields. Prior to 2003, the standard recommendation was for growers to prune off the blossoms (and thus the fruit) in year one and two of planting establishment. However, research on early cropping (i.e., leaving the blossoms) has shown that plants can produce a small yield in year two (1 to 1.5 tons/acre), with no adverse effect. The estimated impact of this research is $50,000 per year in labor savings ($100 x 500 new acres planted) and $675,000 per year in added fruit production (1.5 tons/acre x 250 acres x $0.90/lb). I have conducted 11 workshops on pruning in Oregon and 6 outside my region (WA; CA; Canada; Chile; Italy; Portugal). Other outcomes have been highlighted in field days and blueberry courses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants
215	Biological Control of Pests Affecting Plants
605	Natural Resource and Environmental Economics
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #10

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Evapotranspiration (ET)-based irrigation management optimizes use of water resources, but it requires access to a local data source that is not readily available to the general public in the southern Willamette Valley.

What has been done
Management at the Eugene Airport has agreed to provide a site for an AgriMet weather station. Efforts to secure initial funding for this project are ongoing. Annual maintenance costs will be covered by Lane County Extension

Results
Having local ET data available will allow farmers to more accurately tailor irrigation to the needs of their crops, resulting in more efficient use of water resources. Additionally, reducing over- or under-irrigation can also reduce pest problems. For example, the Pacific Flatheaded Borer (PFB) is a potentially significant pest of young hazelnut trees, but this pest primarily infests stressed trees, and water stress commonly has been associated with PFB infestations. Having a local source of ET data also will enable local research related to crop water needs, such as for blueberries, thus allowing refinement of crop water recommendations to further optimize water use and minimize pest pressures.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
123	Management and Sustainability of Forest Resources
136	Conservation of Biological Diversity
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics

Outcome #11

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 Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The primary goal of this research is to illustrate how decision support tools can be designed to address the farm-scale tradeoffs associated with changes in climatic conditions. We also explore 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 Logic? 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 dry-land wheat producing area of the U.S. Pacific Northwest.

What has been done
AgBiz Logic provides an internally consistent framework for evaluating climate change impacts and investment decisions at the farm scale. Farmers, growers, and land managers can use AgBizClimate to explore near-term projections for average weather conditions (e.g., growing degree days, chilling days) relevant to a commodity in their area. With knowledge of these projected changes, users have an opportunity to adjust their investments, yields and production inputs based on how such changes will affect their production and risk. AgBizClimate linked to AgBiz Logic allows users to step into the world of 20?30 years from present and consider how their current enterprises and operations would continue to serve them in the future, and whether there are any long-range planning decisions they may want to begin considering in order to maintain profitable operations.

Results
Our research illustrates how an integrative decision support tool that is properly fine-tuned for the specific applications can better inform growers and land owners of how changes in climate will impact their operations and their environmental outcomes. AgBizClimate was used to show the impacts of climate change to wheat production. AgBizProfit was used to show adaptation strategies to an annual cropping system. AgBizFinance can be used to show the feasibility of purchasing additional equipment to farm the annual cropping system. AgBizLease showed how changing to an annual cropping system also changes the sharing of the crop, and AgBizEnvironment showed the tradeoffs of economic returns to environmental

impacts.

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
604	Marketing and Distribution Practices
605	Natural Resource and Environmental Economics
723	Hazards to Human Health and Safety

Outcome #12

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Potatoes are an important agricultural industry to the Pacific Northwest (PNW). Production from this region supplies approximately half of all USA potatoes and provides the majority of exports. Farm gate value is roughly $1.7 billion and considering 60% of the PNW is processed, finished value exceeds $3.0 billion and contributes about $1.0 billion of USA exports. A comparison of production and acreage reveals that the PNW is one of the most efficient potato producing regions in the nation and indeed worldwide. However, production efficiency must improve to offset rising input, transportation, and processing costs to keep the PNW potato industry competitive with ever increasing foreign imports.

What has been done
I serve as the principal investigator for on-going field research that includes: potato variety development, pest management, and cultural management practices to improve potato production efficiencies at OSU-KBREC and an active member of the Tri-State Potato Breeding and Variety Development team. This team includes research and Extension faculty from OSU, WSU, U of I, and the USDA/ARS in Aberdeen, ID and Prosser, WA. Variety improvement is the best strategy available to address issues of food supply, nutrition, and impact of agriculture on the environment

Results
The effect of the NWPVD Program on the potato industry has been substantial. The fresh market industry, French fry processors, and chippers have incorporated many NWPVD varieties into their businesses. Ranger Russet, Umatilla Russet and Western Russet, were the 3rd, 4th, and 5th most widely grown varieties in Idaho in 2011, respectively (NASS, Crop Production, November, 2011), accounting for 17% of the ID acreage. Umatilla Russet, Ranger Russet, Alturas, and Premier Russet were the 2nd, 4th, 5th, and 8th most widely grown cultivars in WA in 2011, respectively, accounting for 39% of total acreage. In OR, Ranger Russet, Umatilla Russet, Alturas, Premier Russet, and Modoc ranked 2nd, 4th, 6th, 7th, and 8th, respectively, and accounted for 38% of total potato acreage. Ranger Russet, Umatilla Russet, Alturas, and Premier Russet, were also the 3rd, 4th, 6th, and 10th most widely grown potato varieties in the United States in 2011, with Tri-State varieties representing 21% of the fall crop nationally.
Varieties recently released by the Tri-State program are now produced on over 115,000 acres in the Pacific Northwest with value to growers estimated at approximately $500 million. This impact is expected to increase. For example, Russet Burbank accounted for 47% (218,000 A) of the 2011 ID, OR and WA potato crop. Replacement of only half the current Russet Burbank acreage with Tri-State varieties equals approximately $400 million based on average processing contracts for Russet Burbank.

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
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes 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 #13

1. Outcome Measures

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.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	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, increased temperatures, and drought leading to reductions in summer water availability. In the 2015 drought some growers with junior water rights had their irrigation restricted as early as June. In addition, many new farmers have trouble finding and accessing land with unrestricted irrigation rights. Therefore, it is essential to 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 growing with little or no irrigation.

What has been done
The Dry Farming Project began in 2013 with case studies of farms in Western Oregon and Northern California that produce a variety of fruit and vegetable crops without irrigation. In an effort to disseminate this knowledge to a wider audience, dry farming demonstrations were established in 2015 - 2017 with support from the National Institute for Food and Agriculture?s Beginning Farmer and Rancher Development Program and Western SARE.
The 2015 dry farming demonstration plots were established at OSU?s Oak Creek Center for Urban Horticulture on campus. Squash, melon, potato, tomato, and dry bean cultivars survived an extremely hot and dry growing season without irrigation. A dry farming field day attracted more than 100 growers and stakeholders.
USDA-ARS and local stakeholders interested in biochar research became interested in the dry farming demonstration & research and donated bokashi biochar to include as a treatment at the

Corvallis dry farming demonstration site. As a result the U.S. Biochar Initiative Conference held in Corvallis in August of 2016 asked for two field tours for 100 of their participants.
Our work with the Dry Farming Collaborative is also getting national and international interest. A collaboration is developing with a professor in the country Lebanon. She and her students are doing case studies of dry farming in the rural villages there and there is discussion of doing more as well as some applied research.

Results
Approximately 350 participated in one or more sessions of the 'Growing Resilience: Water Management Workshop Series'. A follow-up survey was sent out to participants and summarized with Qualtrics © (2016, Provo, UT. http://www.qualtrics.com). Twenty-one of the 30 respondents (71%) plan to adopt at least one change including:
?Experiment with or expand dry farming efforts
?Use and put more thought into cover crops and pollinator crops
?Develop water storage systems
?Select sites for dry farming on the basis of soil physical characteristic testing
?Reduce water use and try deficit irrigation
The dry farming project was selected to be part of the national eXtension I-Three Corps. I wrote a blog post about the workshop series (https://extension.org/2016/04/11/i-three-issue-corps-growing-resilience-water-management-workshop-series/), and the project was the featured impact story for the Western region on eXtension.org (https://extension.org/i-three-issue-corps-impact-stories/western-region-story/). This connection was a result of meeting Liz at the eXtension I-Three Issue Corps conference in San Antonio. The Dry Farming Project was one of 72 projects selected nationally to be in the 2016 I-Three Issue Corps.
(https://www.youtube.com/watch?v=FRjDf7x9Tro)

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
112	Watershed Protection and Management
201	Plant Genome, Genetics, and Genetic Mechanisms

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 condit)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

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	8%		5%	
111	Conservation and Efficient Use of Water	8%		5%	
121	Management of Range Resources	8%		0%	
202	Plant Genetic Resources	0%		15%	
204	Plant Product Quality and Utility (Preharvest)	5%		15%	
205	Plant Management Systems	15%		5%	
206	Basic Plant Biology	0%		5%	
216	Integrated Pest Management Systems	15%		5%	
301	Reproductive Performance of Animals	0%		10%	
307	Animal Management Systems	15%		15%	
311	Animal Diseases	10%		10%	
501	New and Improved Food Processing Technologies	0%		10%	
601	Economics of Agricultural Production and Farm Management	5%		0%	
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	5%		0%	
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: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	60.0	0.0	65.0	0.0
Actual Paid	54.0	0.0	10.2	0.0

Actual Volunteer	1859.0	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**
1028088	0	1728345	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1028088	0	16985588	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
3309180	0	26651243	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Oregon's agriculture, food and fiber industry is economically linked to approximately 13.2 percent, $50 billion, of all Oregon sales, 10.6 percent, $22.9 billion, of Oregon's net state product and 13.8 percent, 326,617, of full and part-time jobs in Oregon.
• Oregon's principal operators of farms and ranches make up less than one percent of the total population of Oregon. However, when paid and unpaid on-farm workers are included the total number of workers on the farms and ranches increases to approximately four percent of Oregon's population.
• The number of farms and ranches and total farm acreage has decreased. However the output of Oregon farms has increased 39 percent to $5.7 billion dollars between 2010 and 2014.
The projection that little additional use of land and other agricultural inputs will be needed to meet growing demand is significant. Agricultural production will need to be increased or intensified to meet rising global demand and there is a high level of concern about the environmental impacts of agricultural intensification. Over the last half century, Oregon agriculture has significantly increased the efficiency of how it uses inputs like land, water and chemicals in its production. Between 1960 and 2004, Oregon agriculture lead the nation in growth of efficient use of inputs with an average annual growth rate of total factor productivity (TFP) of 2.58 percent. From 1960 to 2004 Oregon moved from 46th in the nation in 1960 to 15th in 2004. While we have not found a similar long-term study ranking TFP by state, a 2012 global study of TFP showed Oregon continues to improve its use of inputs by 1-3 percent per year.20 Since "It is widely agreed that increased productivity, arising from innovation and changes in technology, is the main contributor to economic growth in U.S. agriculture ," there appears to continue to be high returns to the research and development investment in the agriculture, food and fiber industry for consumers, producers, and ecosystems.

In Oregon there are over 38,000 farms producing 225 crops on over 16 million acres. Because 36% 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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3242	830	984	5389

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	30	89	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of projects addressing animal diseases

Year	Actual
2017	12

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.
26	Traditional agricultural extension programming has been commodity specific and tends to attract operators of medium to large scale farming businesses that focus on a few commodities and wholesale markets. Small scale farmers with diverse operations who tend to focus on direct marketing are a large but historically underserved audience. Improving access to research based information for small scale diverse farms enhances their chance of developing successful farm businesses.
27	Evaluation of forage crops for improved economics and sustainability of animal production systems.

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mycobacterial diseases of animals are serious program worldwide. In agriculture, Mycobacterium avium subsp paratuberculosis, the cause of Johne?s disease, and Mycobacterium bovis, the agent of bovine tuberculosis are associated with significant economic loss and health related issues for animals and humans.

What has been done
Mucosal vaccine against M.tb in humans had already been recently investigated and has shown feasibility to prevent the infection (Caetano et al., 2014; Diogo and Reljic, 2014). Although mucosal vaccine against M. bovis infection of animals was rarely reported, because of the high similarity of M. bovis and M.tb (Garnier et al., 2003), we hypothesized that a mucosal vaccine against M. bovis can also be developed. One of the hypotheses is that the M. bovis bacteria eliminated by the infected host likely have a phenotype acquired in the granuloma environment, therefore exposing the immune system of the new uninfected host to antigens that probably were not present in the BCG vaccine.

Results
Based on the our hypothesis, we plan to investigate (i) if exposure to granulomas-like conditions would have any effect on the binding and uptake of M. bovis by host cells compared with traditional laboratory conditions, (ii) if the granuloma-like condition would influence the expression of surface protein when compared with regular laboratory conditions, (iii) if any surface protein differentially expressed in the two bacterial phenotypes would influence the binding and invasion

of M.bovis BCG, (iv) if the proteins can induce mucosal immune response in vivo.

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
307	Animal Management Systems
601	Economics of Agricultural Production and Farm Management

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Stress from transport may be linked to increased generation of reactive oxygen species, the removal of which requires reduced glutathione and selenium. The aim of this experiment was to examine the effect of transport on glutathione and Se status of feeder lambs.

What has been done

Recently weaned lambs (n = 40) were blocked by gender and BW on d 0 of the experiment and randomly assigned to 2 treatment groups: group 1, no transport and full access to feed and water (control), and group 2, 8-h road transport followed by another 16 h of feed deprivation (transport). After 24 h, both treatment groups were treated the same. All lambs were weighed, and blood samples were collected at 0, 8, 24, and 72 h and analyzed for whole-blood (WB) and serum Se concentrations, serum NEFA concentrations, and erythrocyte concentrations of glutathione.

Results
Transport of feeder lambs for 8 h followed by another 16 h of feed deprivation transiently (significant at 24 h but no longer different at 72 h) decreased BW and erythrocyte glutathione concentrations and increased serum NEFA and blood Se concentrations compared with control lambs. Our results suggest that 8 h of transport followed by another 16 h of feed deprivation results in fatty acid and Se mobilization from tissue stores with a coincident decrease in erythrocyte glutathione concentrations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
206	Basic Plant Biology
301	Reproductive Performance of Animals
307	Animal Management Systems
311	Animal Diseases

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Climate change and warmer temperature have been linked to Ostreid herpesvirus 1 (OsHV-1) outbreaks in Pacific oysters, Crassostrea gigas, in many countries since 2008 (Burge et al., 2006). Now OsHV-1 is one of the important pathogen affecting young as well as adult Pacific oysters C. gigas, worldwide, including US (Burge et al., 2011). Many variants of OsHV-1 have been identified from C. gigas, although some of those variants have not been linked directly to mass mortality in young Pacific oysters (Martenot et al., 2015).

What has been done
At least 9 different genotypes of OsHV-1 were found in both wild and farm raised oysters (Burioli et al., 2016), suggesting a high diversity of genome types in OsHV-1 in natural environments. It is likely that variants of OsHV-1 are present in different oyster species and/or different regions. OsHV-1 is a member of the Herpesvirale, which consists of herpesviruses capable of becoming latent in the infected host. During herpesvirus latent infection, the viral genome is maintained in a few cells which makes it hard to detect.

Results
Although OsHV-1 has not been reported to cause significant disease in the Pacific Northwest, its presence has not been investigated in wild and farm raised oysters in Oregon. In this research application, we hypothesize that OsHV-1 variants are also present in Oregon oysters and that they remain latent in the hosts and thus have the potential to cause diseases under climate changes. To test our hypothesis, we plan to investigate OsHV-1 latent infection in C. gigas produced in Oregon and other parts of the United States. Impact: OsHV-1vaccine strategies in seafood industry.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
307	Animal Management Systems
311	Animal Diseases
501	New and Improved Food Processing Technologies

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Bee pollinators are vital to USA's economy, food security, and environmental health, and hence reports of their declines have raised concerns nationally. For minimizing future losses, bee mortality factors need to be determined. Bees are generalists, and species that pollinate crops are affected by negative factors across the landscape. For instance, recent bee deaths associated with profusely flowering bee attractive linden trees reduced the availability of pollinators for crops in surrounding areas. Impacts
of toxic pesticides in nectar have been examined but little is known about naturally occurring toxic compounds. The challenge
lies in identification of multiple compounds in low volumes of nectar. However, the emerging field of metabolomics now allows
for comprehensive characterization of small molecule metabolites in biological systems. Our goal is to use the metabolomic
profiling approach for determining bee toxic compounds in nectar.

What has been done

For identification of compounds potentially toxic to bees, nectar from linden and non- linden (Abelia) flowers (n=8) were analyzed using metabolomics and HPLC. Higher quantities of glucose, fructose, sucrose, and total sugar were observed in linden nectar compared with Abelia. Mannose, a sugar that researchers believe is the basis for mortality of bees foraging on linden, was not detected in any sample. The LC/MS analysis yielded >30 compounds that varied significantly in quantity between linden and Abelia nectar; PCA (principal component analysis) showed very distinct clusters indicating clear differences in compounds between the nectar of linden and Abelia.

Results

Collection and analysis of nectar from flowers of linden and other plant species, and muscular tissue from healthy and unhealthy bees will continue. Collection techniques will be refined further for enhancing accuracy and detection of more compounds differencing between the two sets of samples in each test. Bees will be frozen immediately on dry ice, and the time between collection and preservation will be reduced to minimize metabolism and preservation of differences between the two cohorts of bees. Targeted metabolic analysis for detection of compounds known to be toxic to bees, such as alkaloids, will be conducted.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

307 Animal Management Systems
311 Animal Diseases

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 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Ovine Enzootic Abortion (OEA) is a disease associated with infection of pregnant ewes by the bacterial pathogen Chlamydia abortus. The pathogen is present in sheep flocks in most countries, including the USA, and can be a substantial burden both in terms of sheep health and economic productivity. In some areas, this disease is a major limitation to profitability.

What has been done
Using culture-independent technologies, recently developed in our laboratory, we have isolated and whole- genome sequenced 12 strains of C. abortus sourced from infected placenta tissues from farms, and acquired and sequenced 6 historical strains. Using comparative genomics, we have obtained a broad view of the variation in genomic structure in populations of the pathogen across a large geographical region.

Our previous results demonstrated that the species is highly conserved across the western USA, perhaps as conserved as any species should be expected to be. This probably stems from its recent separation from the highly variable species, C. psittaci. Also, C. abortus has a very limited host species profile and disease pattern, both of which contribute to its low diversity within the species.

Results
We are currently asking questions about the production, or lack of production, of certain important chlamydial proteins during infection. Genome sequence data suggests that the pathogen differently expresses these proteins, termed Pmp proteins, when cultured in vitro or in vivo. We have conducted extensive PCR-based sequencing to analyze this, and these experiments will

continue. We also are generating a unique collection of antibodies to characterize expression patterns in animals and in vitro. This is challenging work but has been interesting, and we expect that a manuscript about the studies will be generated before June of 2017.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
311	Animal Diseases
601	Economics of Agricultural Production and Farm Management

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
One of the main reasons that the Master Gardener program exists is to offer reliable and relevant research-based information to the general public. Through learning about horticulture and issues associated with plants in the MG training, MGs are able to help the general public sort through plant problems and to provide direction and solution sin helping folks be more successful in their landscaping and gardening. Josephine County citizens have become used to our volunteers providing such support to them and look to us for answers, as we work to provide accurate and reliable information to them.

What has been done
While attempting to create and perpetuate this resource in our county, we provided the 13 week training with classes highlighting a variety of topics, including how to diagnose plant problems, understand insect issues and how to choose, grow, and prune fruit trees correctly. There are

many other topics the students learn that provide them with the information they?ll need to coach and to support the citizens of our county with sustainable solutions to their plant and horticultural needs and problems.
We hold plant clinics four days a week (9 a.m. to 3 p.m. daily) from April through October and two days a week from November through March (10 a.m. to 2 p.m.). This gives the MG volunteers opportunities to do the research and to learn new approaches for information dissemination.

Results
The clients contacted were very satisfied with the service we provided and found the information they received to be very helpful. Approximately 1877 contacts were made with clients in a variety of Plant Clinic venues throughout 2017 with volunteers donating 3604 hours in Plant Clinic settings.

4. Associated Knowledge Areas

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

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The sagebrush ecosystem is the most spatially widespread ecosystem in western North America. Historically, the sagebrush ecosystem occupied over 62 million hectares across the western United States and southwestern Canada, but has become highly fragmented and only occupies about 56% of its historic range. It is one of the most imperiled ecosystems in America, and its decline has negatively impacted more than 350 sagebrush-associated plants and animals.

What has been done
The Oregon State University Extension Service, in collaboration with federal & state agencies, Oregon grazing operators, Boise State University researcher, as well as Idaho and Nevada Extension Services, are creating an integrated ecological approach to increase resilience to disturbance (specifically fire) and resistance to invasive annual grasses within the Wyoming big sagebrush plant communities in ID, NV, and OR. To accomplish this goal, we are test our hypothesis that late-fall (dormant) season cattle grazing can be used to: 1) reduce fine fuels enough to lower fire risks benefiting less fire-adapted native plant species; and 2) promote perennial bunchgrasses by taking advantage of phenological differences between native and invasive annual grasses, and by reducing the amount of plant litter on the soil surface.

Results
During fall of 2017, grazing operators used cattle to reduce fine fuels on nearly 13,000 acres of federal land managed by the Vale District Bureau of Land Management. This same area has a history of wildfire that is perpetuated by fine fuels from invasive annual grasses. To date, three grazing operators reduced their operational costs by $83,200 now that they can use cows as a tool to reduce fine fuels during the fall and winter.

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
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
307	Animal Management Systems
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #8

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Fishermen Led Injury Prevention Program (FLIPP) in the Pacific Northwest aims to study and prevent traumatic injuries in the Dungeness Crab Fleet. The goal is to engage fishermen in research to understand high risk tasks, safety perceptions, and injury prevention opportunities. This study used Coast Guard injury reports and surveys of fishermen to describe patterns of traumatic injury among Dungeness Crab fishermen, as well as identify modifiable hazards. To translate this research into action, injury statistics were disseminated to fishermen to solicit targeted injury prevention ideas that could be implemented and tested. Commercial fishing is a dangerous occupation and the Dungeness crab fleet is considered a high-risk fleet based on fatality rates. This is the first study on non-fatal injuries in this fleet with the goal to develop injury prevention strategies.

What has been done
Injury and incident information was abstracted from 2012-2014 Coast Guard injury reports. The FLIPP survey of crabbing?related injuries and fishermen?s insights on safety was administered in person along the West Coast just before the 2015-16 crab season. Traumatic injury cases were coded using the Occupational Injury and Illness Classification System, an adaptation of the Abbreviated Injury Scale, and a Work Process Classification System. Descriptive statistics from both datasets characterized worker demographics, injuries, and factors relating to injury. The results from the Coast Guard data were discussed with fishermen in focus groups in key fishing ports in Oregon and California before the FLIPP survey was implemented. The results from the FLIPP survey were disseminated just before the 2016-17 crab season by mailing to pot license holders in Washington and Oregon, posting on social media, and in person in key fishing ports. Injury prevention ideas were solicited with stakeholders through a website, conversations in ports and through Oregon Sea Grant Facebook polls.

Results
Forty-five non-fatal injuries were reported to the Coast Guard between 2002-2014. The most frequent injury was to the upper extremities (48%) with fractures being most common (40%) and when fishermen were hauling gear (47%). With 436 fishermen responding to the FLIPP survey in 2015 to report injuries for the previous year, there were 68 injuries that limited the fishermen from continuing work as usual. The majority of limiting injuries (88%) occurred with deckhands. The most common were sprains and strains (36%) and most were associated with handling, hauling, and setting crab pots (72%). General injury prevention ideas about crews and safety training were generated. One idea from fishermen was an engineering control related to handling crab pots. A

gear modification referred to as a ?banger bar? adds padding and a stop bar to the sorting table that a retrieved pot can be tipped and banged against to release the crab. Potential benefits include reduction of awkward postures, forceful exertions and repetitive motions, but the system might affect production and introduce pinch point hazards. After exploring the idea with stakeholders, we learned more information about the use, purpose, and limitations of such a system. We identified factors related to designing for broader use since all vessels, decks and sorting tables vary. In addition, FLIPP conducted a poll through the Oregon Sea Grant Facebook page to solicit input from stakeholders. Sixty people responded to the poll with 78% saying they have used a banger bar. Of 43 comments received, 60% said bars helped dumping pots and/or improved safety. Targeted injury prevention strategies can be informed by injury surveillance and engaging fishermen.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Today, thousands of acres are infested with white rot in CA and the entire Allium industry is threatened by white rot. White rot is also a major problem for onion and garlic seed and bulb production in the Pacific Northwest. White rot-resistant cultivars of garlic and onion are not currently available and growers lack effective control options. Soil fumigants including methyl bromide and metam sodium can reduce white rot sclerotia populations by 99%, but fumigation is

not practical in most situations due to high cost, limited availability, negative environmental impacts, and regulation. This project will investigate an IPM strategy that integrates two control methods, natural sclerotia germination stimulants and fungicides, for managing white rot in onions and garlic. The goal of the research is to find an IPM solution for white rot that: 1) reduces sclerotia populations in infested fields to a level similar to that achieved with metam sodium; 2) allows growers to produce a profitable Allium crop on land infested with white rot; 3) reduces the potential spread and impact of the fungus to new areas; and 4) contributes to the long-term sustainability of CA Allium production.

What has been done
Replicated field trials will be conducted in infested plots located at the UC Intermountain Research and Extension Center and a naturally-infested commercial field in Fresno County. All experiments will be arranged as a split-plot design with four replicates of each treatment combination. Main-plot treatments include sclerotial germination stimulants and fumigation. Main-plot treatments will be applied one year before growing onions in the spring when soil temperature and soil moisture are conducive to germinating sclerotia. A control treatment consisting of no germination stimulant will be included. After germination stimulant treatments are applied a non-host crop, wheat, will be planted for grain. Subplot treatments will be fungicides applied in-furrow at the time of planting onions. Several UC experiments conducted over the last 10 years evaluated the efficacy and crop safety of fungicides for white rot control in onions. Tebuconazole and penthiopyrad (applied in-furrow at planting) and an untreated control will be included as sub-plot treatments. Soils will be sampled and the number of white rot sclerotia will be quantified in each subplot to establish the baseline fungus populations prior to treatment application. Soil samples will be collected 3 months
following germination stimulant treatment application and shortly before planting onions. Lab analysis performed by Oregon State University will determine the number of sclerotia in soil samples. At crop maturity, onions will be harvested, sorted, and examined to determine yield, white rot severity, and the percentage of bulbs not acceptable for fresh and processing food uses due to white rot.

Results
Expected outcomes from this project include the: 1) identification of sulfur compounds/products that stimulate germination of white rot sclerotia; 2) comparison of white rot sclerotia germination stimulants with products that were previously shown to be effective but are no longer feasible/available (e.g. metam sodium, diallyl disulfide); 3) evaluation of an IPM approach that combines fungicides and sclerotia germination stimulants to reduce white rot symptoms and produce yields that are profitable for growers and acceptable for food processors.

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
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
White mold is a fungal disease that can affect many crop plants and common bean (and especially snap bean) is particularly susceptible. Snap beans grown for processing may be rejected at the processing plant is a lot comes in to the cannery with more than 3% moldy pods. Fungicides are available for control of this disease, but these are costly and require more than one application. Before white mold was a major problem, the crop was a profitable one; now growers barely break even and they need cultivars that are resistant and do not require fungicide applications. Genetic resistance is generally conditioned by multiple genes with small individual effect and resistance is generally found in unadapted bean lines. These can be crossed to snap bean to create populations for breeding for resistance and that can be used to study the trait, how it is inherited and what
markers and genes are linked to resistance. Markers can then be used to assist in the breeding process for introgressing resistance into elite snap bean breeding lines. Resistance from multiple sources can be pyramided into a common elite background through marker assisted selection.

What has been done
Crosses are made between unadapted sources of resistance and OSU cultivars and breeding lines to produce recombinant inbred populations in order to analyze resistance (mode, complexity, inheritance, linkages) using molecular markers. Once resistance factors are identified, these are incorporated using marker assisted selection in single seed descent or backcross
breeding programs. Resistance is tested in greenhouse and field trialing programs. Greenhouse testing is conducted using the straw test on individual plants. In the field, plants are grown in replicated plots in fields with a history of white mold, then are culturally managed to create conditions favorable for disease. At physiological maturity, plants are evaluated for incidence and

severity of disease.

Results
Green bean growers and processors will have snap bean cultivars that require lower rates of fungicide treatment to prevent white mold disease. This will reduce costs and increase profits for growers and processors.

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
601	Economics of Agricultural Production and Farm Management

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Understanding how bacteria affect plant health is crucial for developing sustainable crop production systems. We coupled ecological sampling and genome sequencing to characterize the population genetic history of Rhodococcus and the distribution patterns of virulence plasmids in isolates from nurseries.

What has been done
Analysis of chromosome sequences shows that plants host multiple lineages of Rhodococcus, and suggested that these bacteria are transmitted due to independent introductions, reservoir populations, and point source outbreaks. We demonstrate that isolates lacking virulence genes promote beneficial plant growth, and that the acquisition of a virulence plasmid is sufficient to transition beneficial symbionts to phytopathogens.

Results
This evolutionary transition, along with the distribution patterns of plasmids, reveals the impact of horizontal gene transfer in rapidly generating new pathogenic lineages and provides an alternative explanation for pathogen transmission patterns. Results also uncovered a misdiagnosed epidemic that implicated beneficial Rhodococcus bacteria as pathogens of pistachio. The misdiagnosis perpetuated the unnecessary removal of trees and exacerbated economic losses.

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
601	Economics of Agricultural Production and Farm Management

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The most recent USDA Census of Agriculture reports women comprise 14% of principal operators and 30% of all farm operators. The number of U.S. farms operated by women nearly tripled over the past three and a half decades, from 5 percent in 1978 to 14 percent most recently (Census of Ag, 2012).

The increase in the numbers of farms and ranches operated by women is not without some challenges. Many women are drawn to farming as a way to support their family and to strengthen local community yet more than 90% of women-operated farms reported gross sales and government payments of less than $50,000. Women operators are still not applying for and utilizing agricultural programs as effectively as their male counterparts and the businesses of many beginning farm and ranch women are not surviving the first five years (Peabody, 2015).

As the number of women operators increases, so does the number of programs developed to provide education and technical assistance to them. While these programs develop successful tools and techniques for addressing the needs of beginning farmers and ranchers, there are many areas where women remain under-served.

What has been done

OSU Small Farms faculty and staff hosted four hundred agricultural producers and professionals at the National Women in Sustainable Agriculture conference, held for the first time in the western US. The conference included two keynote speakers; forty-two workshops on sustainable agriculture; an experienced farmer panel discussion; and networking sessions. Women farmers were provided with opportunities to learn about specific topics in sustainable agriculture, as well as to train agricultural professionals how to better support women farmers.

Workshop proposals were solicited six months before the conference resulting in 82 submitted proposals. Conference activities included: 2 on-farm demonstrations, 8 farm tours,47 presentations and 1 published press article.

Results

Surveys taken one month and nine months after the conference provided the following impact information: 240 agricultural service provider participants used knowledge and skills learned through this project (or incorporated project materials) in their educational activities, services, information products and/or tools for farmers.

In a survey taken nine months after the conference, 26% of respondents said they had applied a new skill, technique or practice learned at the conference, 24% had taken action on an issue of policy or advocacy, and 49% used information learned in teaching, outreach or work.

In terms of networking that took place after the conference, 10% collaborated with another attendee on a project, grant, or program after the conference, 10% sought or received technical information from another attendee, 8% consulted with another attendee to solve a problem, 10% made a business contact, and 23% made a professional contact.

Additionally, 65% of attendees reported that attending a conference specifically for women had significant advantages over other more general agricultural conferences you have attended while 43% reported that there were some advantages.

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
216	Integrated Pest Management Systems
301	Reproductive Performance of Animals
307	Animal Management Systems
311	Animal Diseases
501	New and Improved Food Processing Technologies
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The number of women in agriculture increases every year. In Marion County, the number of women-owned businesses has been steadily increasing, from 26% to 34% from 2000 to 2012 (US Census Bureau). However, women face unique challenges growing viable businesses in farming. They often are not taken as seriously as men when seeking loans and insurance, may

feel unwelcome at predominantly men?s farming meetings, and often need off-farm income which requires working during the day and farming on evenings and weekends. The Mid-Valley Small Farms team strives to support the success of all small farms and to empower women in agriculture to achieve goals through education and networking.

What has been done
The Mid-Valley Small Farms team hosted the Salem site of WSU's Women in Agriculture Conference in November, 2017. Promotion of the event utilized the newly created Facebook page, website, and MailChimp online newsletter mailings, as well as fostered collaboration with local news and key community partners. A panel of three local female farmers were recruited to discuss their leadership roles within their agricultural communities and a local food vendor was selected to highlight local agriculture during the provided lunch. Participants were encouraged to connect with each other and discuss common challenges during break-out sessions and networking opportunities.

Results
In years past, Marion County Extension Service has seen attendance of approximately 8 people for this event. The 2017 Women in Agriculture Conference in Salem attracted 24 participants, including a visit from Alexis Taylor, the Director of the Oregon Department of Agriculture. This year's event also brought 3 OSU students to the Marion County Extension office, strengthening Extension's connection to OSU students. The take-away messages from participants included getting more involved in their communities or local organizations in leadership positions, finding or becoming a mentor, and supporting other women in agriculture. One participant noted, "Great networking - met many wonderful women [with] whom I'll connect in the future. Feel re-motivated and hopeful. Thank you!"

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
To understand how ecology and human interactions affect the health of fishes, we must accurately understand fish biodiversity and distribution. In other words, we need to know which fish species exist, where they occur in the world, what habitats they inhabit, and how their distributions have changed over time. This project will link specimens and data from natural history collections like the Oregon State Ichthyology Collection to help the overarching project create and improve a map of fish biodiversity throughout the United States. We will work to create species distribution maps, add data from historical specimens to online databases, understand where genetic boundaries between populations and species exist, update and improve identification keys and guides, and link specimen and collection data to geographic information of ecology, climate, and human
impacts that can be used to help acheive the overall project's analysis, research and outreach objectives.

What has been done
Methods will include genetic and morphometric identification and analysis of fish specimens collected over the last 100 years and preserved in natural history collections. Data will be cataloged in collections management software such as Specify 6.1, and served to other consortium members through the Oregon State Ichthyology Collection's website (www.ichthyology.oregonstate.edu) as well as clearinghouses such as GBIF, iDigBio and

Results
To understand the ecological and socioeconomic factors that structure and affect the health of fish communities, one must first ensure a detailed and accurate understanding of which species exist in each community, and how the composition of those communities varies across time and space. In effect, one needs to understand which fish species exist, where they occur, and how those distributions have changed over time. This project will leverage specimens and data from the Oregon State Ichthyology Collection and other similar natural history collections to help achieve that spatial and temporal map of fish community composition. Products may include improved species distribution maps, the addition of dark data from specimen backlogs into global biodiversity clearinghouses like iDigBio and GBIF, the description of new species, improved dichotomous keys and identification guides, elucidiation of the geographic boundaries among genetically distinct populations, and the creation of geospatial links between specimen and collection data to layers of ecological, climate, or sociological data that can be used to help acheive the overarching collaboration's analysis and outreach objectives.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems

311	Animal Diseases
601	Economics of Agricultural Production and Farm Management
903	Communication, Education, and Information Delivery

Outcome #15

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
We propose to investigate and integrate the effects of top-down (predation) and bottom-up (food for rodents) forces on pathogen amplification in eastern deciduous forests. We will determine the net effects of acorns and predator community structure on the risk of exposure to three emerging diseases -- Lyme disease, anaplasmosis, and babesiosis. If infectious diseases are sensitive to changes in predation, then the continuing widespread extirpation of top predators and the consequent restructuring of predator communities may have important consequences for vertebrate communities, with spillover consequences for human health. The proposed research takes a community perspective to prey population dynamics to test whether predator interference (coyotes suppressing fox) decreases predation rates on pathogen-amplifying hosts with cascading impacts on the abundance and infection prevalence of the tick vectors that parasitize them.

What has been done
The current research will not include any field methods. We will analyze existing data on acorns, rodent density, tick abundance, and tick infection prevalence while working with Rick Ostfeld and Charles Canham from the Cary Institute of Ecosystem Studies.

Results
The proposed research takes a community perspective to prey population dynamics to test whether predator interference (coyotes suppressing fox) decreases predation rates on pathogen-amplifying hosts with cascading impacts on the abundance and infection prevalence of the tick vectors that parasitize them. I expect to identify drivers of tick density and infection prevalence using long term data from the Cary Institute of Ecosystem Studies as well as field data that I have collected on carnivore community structure. The results will be published in peerreviewed literature.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
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.

Not Reporting on this Outcome Measure

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Equine Infectious Anemia (EIA) is an infectious disease that threatens the world?s horse, donkey and mule populations. There is no cure for EIA and the disease is often fatal. If the horse survives the initial effects of the disease, they are carriers for life. EIA is transmitted by blood, semen, milk or in-utero passage from mare to foal. Mosquitos, horse flies and other biting insects can transmit the disease, making it difficult to contain the disease once an outbreak occurs. One?fifth of a teaspoon of blood from a horse with acute EIA contains enough virus to infect one million horses.

What has been done
, I organize and facilitate an annual Coggins testing and equine vaccination clinic in May. OSU Extension collaborates with USDA-APHIS for free veterinary services, and USDA-National Institute of Food and Agriculture (USDA-NIFA) to provide partial funding for the clinic. I send out a press release every year in April reminding tribal members about the dangers of EIA and the importance of testing horses for EIA and vaccinating horses for other common equine diseases such as equine influenza, sleeping sickness and tetanus to name a few. Tribal members are encouraged to register for the clinic and take advantage of the low cost testing and vaccinations. They have to pay for the cost of the test and vaccines, but the veterinarian work is free. I schedule the tribal members and the USDA-APHIS veterinarians and the clinic is held annually at the rodeo grounds in Warm Springs. If a tribal member has more than four horses, we will travel to their home or ranch to vaccinate horses. By providing these low cost vaccinations, USDA-APHIS is able to continue monitoring Warm Springs horses for EIA.

Results
An average cost of having a horse tested for Coggins runs about $20-25 dollars plus veterinarian costs of approximately $100 per hour. If you bring a single horse into the veterinarian for a Coggins test, it will be approximately $125.00. By providing free veterinarian services and a discounted rate for the Coggins test, tribal members only pay $10 for the Coggins test. This equates to a savings of $110 per horse. OSU Extension has averaged 30 horses tested each year for a total savings of $3,300 per year or $6,600 in the last two years for tribal members. In addition, USDA-APHIS is able to perform services on the reservation that allows them to check for cases of Equine Infectious Anemia.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems
311	Animal Diseases
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Our goal was to test whether feeding Se-fertilized forage increases WB-Se concentrations and performance in weaned beef calves.A second goal was to test whether beef calves fed Se-enriched alfalfa hay during the transition period between weaning and movement to a feedlot also have improved immune responses and slaughter weights

What has been done
During the last 8-weeks before calving, dairy cows at a commercial farm were fed either 0 (control) or 105 mg Se-yeast once weekly (supranutritional Se-yeast), in addition to Na selenite at 0.3 mg Se/kg dry matter in their rations. Concentrations of whole-blood (WB) Se and serum Se, erythrocyte glutathione (GSH), and serum albumin, cholesterol, α-tocopherol, haptoglobin, serum amyloid A (SAA), calcium, magnesium, phosphorus, non-esterified fatty acids, and β-hydroxybutyrate were measured directly after calving, at 48 h, and 14 days of lactation in 10 cows of each group. Supranutritional Se-yeast supplementation affected indicators of antioxidant status and inflammation.

Results
Cows fed a supranutritional Se-yeast supplement during the last 8-weeks of gestation had higher Se concentrations in WB (overall 52 % higher) and serum (overall 36 % higher) at all-time points, had higher SAA concentrations at 48 h (98 % higher), had higher erythrocyte GSH (38 % higher) and serum albumin concentrations (6.6 % higher) at 14 days, and had lower serum cholesterol concentrations and higher α tocopherol/cholesterol ratios at calving and at 48 h compared with control cows. In conclusion, feeding Se-replete cows during late gestation a supranutritional Se-yeast supplement improves antioxidant status and immune responses after calving without negatively impacting other micronutrients and energy status.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
307	Animal Management Systems
311	Animal Diseases
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

Outcome #20

1. Outcome Measures

Evaluate the toxicity of various mycotoxins in food.

Not Reporting on this Outcome Measure

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

This project involves the study of a disease called Victoria blight which was originally identified on the host plant, oats. The disease is caused by the fungus, Cochliobolus victoriae which can only infect oats if it makes a peptide called "victorin" and interacts with oats carrying a gene called "Vb". Various analyses suggest that the Vb gene, which confers Victoria blight susceptibility and sensitivity to victorin, is identical to a gene called Pc2 which confers resistance to a different disease called "crown rust of oats" caused by the fungus Puccinia coronata. Consistent with this interpretation, molecular analyses reveal that victorin activates a resistance protein (NB-LRR) which leads to cell death and that C. victoriae exploits this defense response to cause disease. This conclusion is further supported by the finding that victorin sensitivity is conditioned by genes encoding resistance proteins across diverse crop species including barley, rice and bean. We hypothesize that these resistance proteins (NB-LRRs) are functionally, and perhaps structurally, related to the protein encoded by the Vb/Pc2 gene in oats.

What has been done

The discovery of victorin sensitivity in Arabidopsis, a species considerably divergent from oats, led us to investigate other plant species with an eye toward further understanding victorin's mode-of-action and ultimately identifying Vb/Pc2 in oats. We identified sensitivity in common bean, barley, Brachypodium and rice. Mapping data indicted that in all species, sensitivity is conferred by R-like genes (i.e. genes encoding NB-LRRs). Because these genes recognize victorin, they share
recognition specificity with Vb in oats. Further, if Vb and Pc2 are identical, then, by definition, Vb/Pc2 confers shared recognition of both victorin and AvrPc2 from P. coronata. Thus, we hypothesize that genes conferring victorin sensitivity from these other species may also confer rust resistance in oats.

Results

Based on our previous identification of victorin sensitivity in a number of diverse plant species and our mapping results across several of these species identifying NB-LRRs as causal to victorin sensitivity, we hypothesize that the Victoria blight susceptibility gene in oats, (Vb) is also a NB-LRR and further, that this same gene is the Pc2 gene, which confers resistance to the crown rust pathogen, Puccinia coronata. Further, we speculate that genes conferring sensitivity in other species could share a structural relationship and likely do share a functional relationship with this oat gene. Because Vb and Pc2 likely share identity, we hypothesize that P. coronata produces an effector that in some manner mimics victorin. Thus the genes identified among these different species that recognize victorin may also recognize AvrPc2 and therefore, could have utility in conferring crown rust resistance in oats. Finally, we hypothesize that continued genetic evaluation of Arabidopsis can add additional insight into the mode-of-action of victorin and by association, the functions of the corresponding biotrophic effector from the crown rust pathogen, P. coronata. This is important for understanding necrotrophic virulence and also because crown rust and cereal rusts in general are formidable pathogens for which few effectors have been characterized. Completing the objectives of this proposal will provide insights into all of these issues.

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

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
2017	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

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Greenhouse and nursery production, comprising the largest sector of agriculture in Oregon, has a variety of educational needs in the area of Integrated Pest Management (IPM). This export-dominated industry has high quality expectations, low pest tolerance, and extremely low damage thresholds complicating pest management activities. In order to address these needs, an IPM educational program has been developed to give growers access to detailed IPM information across a diverse spectrum of pests.

What has been done
Activities: In 2014, the major activities of the Nursery IPM program included; 1) the Pacific Northwest IPM website, 2) Social Media Outreach, 3) OktoberPest workshops, 4) Bug in the System workshop, 6) Cover Your Assets workshop and 5) Invasive species awareness, 6) Enhancing Water Quality, and Pollinator Protection.
IPM Alerts
The IPM alert system is an informational listserv for ornamental integrated pest management (IPM). There are over 617 subscribers to the pest alert system in 26 states (AK, AL, CA, CO, DE, FL, GA, HI, ID, IL, KY, MD, MN, MT, NC, NE, NV, OK, OR, PA, SC, TN, TX, VA, WA, WI) in the

U.S and three Canadian Provinces (BC, ON, NS). The subscribers include growers, consultants, Extension Agents, educators, landscapers, public employees, researchers, and regulatory personnel. Subscribers to the pest alerts receive an average of 4 ½ alerts/week with information on weather, pest activity, and pest- or pesticide-related information.

Results
The IPM alert system was mentioned by Dr. Lance Osborne, University of Florida, in communications of the OrnaEnt Listserv, as one of the best sources of information on invasive species activity. Growers report they have improved monitoring, identification, and management based on the alert system.

4. Associated Knowledge Areas

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

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Enhancing seed germination is important while preventing precocious germination from developing grains is also important. In this project, the mechanisms of seed germination will be investigated so that the knowledge can be used to develop technologies to promote or suppress seed germination. The outcomes of this project will contribute to global food security.

What has been done

Biochemical, molecular and genetic approaches will be integrated to dissect the mechanisms of seed dormancy and germination. Bioinformatics will also be employed. Basic experiments using the model plant Arabidopsis will be extended to agricultural crops, such as wheat.
As the most updated experimental plans: Genes associated with seed dormancy and germination, including long non-coding RNAs, will be identified by RNA sequencing of the Arabidopsis mutants, which were created recently. Using the Plant Gene Switch System (Martinez-Andujar et al., 2011; PNAS 108 17225-17229) and the spontaneous ABA (abscisic acid) amplification system (Nonogaki et al., 2014; Plant J. 78:527-539), sequencing of messenger RNA and non-coding RNA will be performed. The function of identified genes will be examined by inducing them in transgenic plants and further checking the downstream changes, in terms of gene expression profiles.
Enhancement of seed germination will be examined using gene induction with the Nitrite Reductase 1 (NIR1) prompter (pNIR1).
Anti-NCED (nine-cis-epoxycarotenoid dioxygenase) or other genes with promotive effects to seed germination will be induced.

Results

Expected outcomes of the project are new knowledge about the mechanisms of seed dormancy and germination and potentially new technologies to suppress or enhance seed germination, which can be applied to many different agricultural species.

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
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Wheat quality is defined by its diverse end-uses. Wheats unique and varied processing attributes, as well as tradition, produced many market classes based on end-use quality and specialized industries capture value from those classes. Many scientific disciplines, both public and private, seek to improve the quality components of all market classes of wheat. The farming community, milling and baking industries, and the entire wheat industry recognize the need to coordinate quality improvement efforts.

What has been done
Further coordination of breeding and extension testing can identify environmental areas conducive to high quality wheat production for specific market classes. Expertise, superior germplasm and optimal production areas can combine to meet market needs and opportunities. 2. Information exchange occurs at the yearly project meeting and throughout the year through working relationships developed in the project. A Web site will be established in association with the USDA/ARS Western Wheat Quality Lab to facilitate information exchange in the interval between meetings. 3. Analysis of Regional nursery samples by the USDA/ARS Wheat Quality Lab provides quality information on a standard set of lines grown across a wide variety of environments. This information not only enables the breeder to know how widely adapted his or her lines are with respect to quality, but also could inform industry as to which cultivars have promise for their purchasing area. The relatively large amount of seed per cultivar generated by the regional nurseries allows the USDA/ARS Wheat Quality Lab to conduct more extensive quality evaluations. Most Western states also conduct extension testing of new cultivars in on-farm trials to determine local adaptation in farm production settings. Like the regional testing system, the grain produced in the extension testing system is evaluated for end-use quality. 4. The influence of genotype, environment, and their interaction on end-use quality can be established using nursery samples as well as yield trial seed. Individual state and ARS laboratories will conduct small sample
evaluation for protein quality (SDS sedimentation or SRC lactic acid), color (using PPO tests or Minolta values on noodle sheets), test weight and kernel hardness, etc. Wheat quality laboratories use these triasl to develop quality indices and to cull wheat cultivars of undesirable quality before they reach wide production. 5. Molecular markers may pinpoint quality traits. Instrumentation such as TxTA2 texture analyzer and the Rapid Viscoanalyzer are providing extensive measurements of enduse, but linkage to industry evaluation and criteria point out the significance of those measurements. Identification of new methods for assessing and selecting quality must tie to measures of value by the end-users.

Results
Public and private wheat breeding and cultivar testing programs in Idaho, Oregon and Washington will be coordinated for enduse quality evaluation with participation of other western state programs strongly encouraged.
Ideas and information will be exchanged among university and industry personnel during annual meetings.
Preferred cultivar lists will be published in cooperation with wheat grower organizations.
Methods of wheat quality testing will be standardized across participating institutions.
Acreage of cultivars with improved end-use quality will increase across the PNW and the greater western region of the United States.

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
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #26

1. Outcome Measures

Traditional agricultural extension programming has been commodity specific and tends to attract operators of medium to large scale farming businesses that focus on a few commodities and wholesale markets. Small scale farmers with diverse operations who tend to focus on direct marketing are a large but historically underserved audience. Improving access to research based information for small scale diverse farms enhances their chance of developing successful farm businesses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Starting mid-2016, Javier Fernandez-Salvador began mentoring undergraduate students involved in the Organic Berry Project with the OSU Organic Growers Club. Using this resource for evaluation and recruiting of students, the small farms program began to explore the options with the newly formed Beginner and Continuing Researcher Program for Undergraduates in the College of Ag. Intensive mentoring, including training, hands-on practical career development activities, writing exercises, and expansion of responsibilities have produced a program that now relies on the assistance from undergraduates.

What has been done

Outcome

The mid-Willamette Valley small farms program now works with and mentors six undergraduate students in multiple departments including Ag Education, Horticulture, Ag Research and Crop and Soil Science. Undergraduates actively participate in four research and education projects including cover crops, olive orchard establishment, organic strawberry production, and small farm needs assessment. Participatory research with growers an important aspect of the student mentoring that the Extension Service in our counties can develop. This will be the year where our first mentoree will graduate with a B.S. and now has her own organic consulting business. Other students that will graduate the following year are mostly interested in graduate school and other research opportunities.

Results

The team is working on publication of various articles, including Feasibility of Food Hub, Olive Production in a non-traditional region, Propagation of Olives in Oregon Conditions, Evaluation of Cultivars for Winter Olive Hardiness, Strawberry and Orchard Cover Cropping for Soil Health and Nutrient Management, and Mixed Methodology for Assessing Small Farm Research Needs

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
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
206	Basic Plant Biology
501	New and Improved Food Processing Technologies
601	Economics of Agricultural Production and Farm Management
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
903	Communication, Education, and Information Delivery

Outcome #27

1. Outcome Measures

Evaluation of forage crops for improved economics and sustainability of animal production systems.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
AES projects were designed to work on regionally important economic projects both in basic and applied agricultural sciences. The background/overview of the lab is that it does $275,000 worth of assays that help insure tall fescue, perennial ryegrass, and ergot containing straw shipments for the Far East are below threshold values.

What has been done
Work has progressed on understanding how these mycotoxins elicit clinical signs which impact livestock production including decreased weight gain and diminished reproductive performance. In addition, we have begun delineating the metabolism of these toxins in animals so that a better risk assessment can be conducted which evaluates the presence of these toxins and their metabolites in by- products available for human consumption. Research on these toxins is warranted, as the possible impact of bioaccumulation of these toxins under varying exposure conditions on both toxicity and as residues in food products has not been thoroughly investigated and could affect the manner by which these compounds are regulated. The underlying theme of our work to date is the promotion of safe livestock feed through a joint service-research laboratory environment. Our long-term goal is that, by better understanding the etiology of the diseases caused by endophyte/mycotoxins and ergot, development of more effective preventative and/or therapeutic measures can be realized.

Results
Since these test to insure safe feed started in 2000, the number of clinical cases of endophyte disease seen in Japan has dropped from 54,000 cases in 2000 to zero cases over the past five years. Fescue toxicosis, perennial ryegrass staggers and a new emerging disease, Claviceps purpurea (ergot) are some of the most common toxic plant diseases plaguing livestock in the Western United States. They result from consumption of forage containing the endophyte-

produced mycotoxins ergovaline and lysergic acid (fescue toxicosis) and lolitrem B (ryegrass staggers). It is estimated that the toxicological effects of ergot and lolitrem alkaloids cost between $0.5 and $1 billion in livestock losses annually in the United States alone.

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

Research continues to increase agricultural yields and improve practices, particularly in developing countries. Increasing yields means that more food can be grown on fewer acres, alleviating the need to clear additional land, including forests, for agriculture. Yet, high-yield farming methods are also criticized for their effects on the environment. A reliance on fertilizers and pesticides, if improperly managed, can significantly alter rivers and streams, while irrigation can deplete groundwater supplies and contribute to salinization of the soil.
Improved management techniques have reduced these effects in some regions. But, to address some concerns and ensure the future sustainability of agricultural production, researchers are starting to emphasize "agro-diversity"--a combination of smaller-scale, locally-based polyculture production methods, genetically disease and pesticide resistant crops, and high-yield innovation. In addition, high-tech methods are increasingly being implemented, including using computers and sensors to monitor crops so that pesticides and water can be applied with precision.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

• Expanding access to agricultural sciences to multi-cultural students to improve food production globally.

- Improved vaccines and antibiotics for animal production systems
- Adopting new agronomic practices for organic production
- Breeding new cultivars for changing industry and consumer needs
- Providing new landowners with land stewardship and conservation training
- Improving the nutritional value of forages to reduce land impacts
- Improving the nutritional value of commodity crops.

- Improving aquaculture production systems

- Applying genomic approaches to eradicating Sudden Oak Death

Key Items of Evaluation

OSU research and extension scientists continue to expand knowledge and agronomic principles for over 226 crops and livestock production systems. New genomic methods of cultivar improvement and for addressing pathogens will continue to improve yields and economic vitality for Oregon producers

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
204	Plant Product Quality and Utility (Preharvest)	0%		10%	
306	Environmental Stress in Animals	0%		5%	
308	Improved Animal Products (Before Harvest)	0%		10%	
311	Animal Diseases	2%		5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	0%		5%	
501	New and Improved Food Processing Technologies	12%		10%	
502	New and Improved Food Products	11%		5%	
603	Market Economics	0%		5%	
607	Consumer Economics	0%		5%	
701	Nutrient Composition of Food	12%		5%	
702	Requirements and Function of Nutrients and Other Food Components	0%		5%	
703	Nutrition Education and Behavior	15%		5%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	12%		5%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		5%	
723	Hazards to Human Health and Safety	10%		5%	
724	Healthy Lifestyle	8%		5%	
903	Communication, Education, and Information Delivery	8%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	6.0	0.0	25.0	0.0
Actual Paid	6.0	0.0	3.9	0.0
Actual Volunteer	309.0	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**
115659	0	647746	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
115659	0	6384502	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
372282	0	2453919	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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1469	696	734	2089

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	52	61	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of people trained to meet requirements of FSMA

Year	Actual
2017	137

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	Apply principals of integrated pest management and integrated crop management to improve food safety and environmental impacts of agricultural production.

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Mouse transplacental cancer studies- Exposure of the fetus to environmental carcinogens, such as polycyclic aromatic hydrocarbons, results in cancers later in life. We seek to understand the contribution of genotoxicity by this important class of environmental carcinogens versus alteration of the fetal epigenome to maximize the effectiveness of chemopreventive dietary agents such as indole-3-carbinol from cruciferous vegetables. Results from these studies can be used to improve risk assessment and reduction for the sensitive fetus.
Human studies- These studies are founded on a strong premise and promise high impact for assessing carcinogen exposure and approaches for risk reduction. The remarkable technology of AMS, enhanced by ULPC, allows studying in humans the absorption, metabolism and excretion of an important environmental carcinogen. Results from these studies can be used to improve risk assessment and risk reduction in the general population for an environmental carcinogen associated with lung cancer, the major cause of cancer in humans worldwide.

What has been done
Transplacental exposure to PAHs and cancer in the offspring: Specific aim (1a) Bioavailability to, and Metabolism of, BaP in Fetal/Neonatal Tissues- Pregnant mice are dosed with [14C]-BaP. Utilizing ULPC and radioisotope detection, we will assess parent [14C]-BaP and metabolite profiles as well as DNA adduction in thymus, lung and liver in neonates of newborns. Examine expression in neonatal thymus, lung and liver of mRNA via RNAseq, micro(mi)RNAs via smallRNAseq, Dnmt
methylation of the AhR promoter and AhR-targeted genes by ChIPseq- Neonatal thymus, lung and liver are analyzed by RNAseq, smallRNAseq and AhR ChIPseq. I3C and transplacental chemoprevention of BaP and DBC carcinogenesis- Tumor studies are conducted with pregnant mice fed 2000 ppm I3C throughout pregnancy. Neonates will be examined for covalent DNA

adduction in lung and thymus. Remaining tissue is analyzed by RNAseq, smallRNAseq and ChIPseq). A complete necropsy performed at 12 months of age. The PK parameters will be assessed and the impact of Brussels sprout or DIM consumption on uptake and elimination of [14C]-BaP and each metabolite determined. Levels of cruciferous vegetable or DIM consumption prior to [14C]-BaP dosing for each individual will be correlated with PK parameters and metabolite profiles to assess and compare the impact of the whole food as well as potential mechanism of action (e.g., reduction in GI uptake, CYP-dependent metabolism, rate of elimination). Dr. Tilton will utilize this data (along with genotyping) to model chemopreventive mechanisms of Brussels sprouts and DIM following micro-dosing of [14C]-BaP.

Results

We expect to determine how rapidly oral ingested [14C]-BaP is absorped into blood, metabolized by liver (including the identity of the metabolites) and excreted in urine. This will be the first dataset of its kind and will be used to build a physiologically-based pharmacokinetic (PBPK) model for human exposure to carcinogenic polycyclic aromatic hydrocarbons (PAHs) such as BaP.

We will share this dataset and modeling with FDA and EPA in an effort to enhance their accuracy in performing risk assessment for PAHs in the diet. If we find that indeed Brussels sprouts and/or DIM lower BaP exposure by enhancing metabolism and excretion we will share that information with regulatory agencies, other scientists and stakeholders. The communications will be in the form of presentation at scientific meetings, peer-reviewed publications and media stories.

4. Associated Knowledge Areas

KA Code	Knowledge Area
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Beef Quality Assurance (BQA) is a national program developed by producers for producers. The goal of the program is to raise consumer confidence by training the cattle industry workforce in proper management techniques to ensure a safe and quality beef product. Trained cattle handlers following the BQA guidelines are less likely to adulterate the beef product and more likely to promote an economically viable beef product.

What has been done
In 2015, Malheur County feedlot insisted on receiving OSU Extension Service certification. Interestingly, they also requested the training in Spanish to reach non-English speakers processing cattle. Therefore, I coordinated with the Extension Beef Specialist, Dr. Reinaldo Cooke, to become the second Oregon State BQA Coordinator(represented OSU at national BQA meeting). Beyond the national BQA program, producers and management at the local auction barn (Producers Livestock Marketing Association-Vale, OR) requested socially diligent best management practices.

Results
As a state BQA Coordinator, I facilitated two workshops and presented three times to certify/recertify 65 cow-calf producers, feedlot managers, and feedlot processors through the national BQA program. My bilingual extension program allows OSU Extension Service to reach a broader audience by offering these BQA trainings for English and Spanish populations. Currently, five Spanish-speaking feedlot processors obtained certifications. Furthermore, I organized, facilitated, and presented a low-stress cattle handling workshop with the manager of Producers Livestock Marketing Association in Vale, OR, the regional territory manager for Boehringer Ingelheim, Utah State University Extension Livestock Specialist, and Chris Schachtschneider?Livestock/Rangeland/Forage Field Faculty for Morrow and Umatilla Counties. A total of 49 auction barn workers, cow-calf producers, and feedlot operators attended the workshops and 100% of the respondents that returned an evaluation indicated that they would implement a low-stress cattle management technique learned at the workshop.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals

308	Improved Animal Products (Before Harvest)
311	Animal Diseases
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
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Foodborne illness remains a significant public health problem in the United States with an estimated 48 million cases and cost of $89 billion annually. Research conducted under this program will lead to a better understanding of food contamination and will investigate and validate solutions for producing and processing safer foods. Due to the complexity of food products and its desired end use, production and processing interventions will be specific and tailored to individual commodities or categories. Food safety research projects will be varied in their methodology depending on the required research for the commodity or food category. In general, prevalence studies and validation studies will focus on detecting and inactivating Salmonella and other foodborne pathogens. Prevalence studies will utilize the statistical and microbiological approaches to identify likelihood and quantity of contamination in specific food commodites. Inactivation and process validation studies will quantify the efficacy of specific process to reduce contamination levels while retaining maximum product quality. Results from these studies will be communicated directly to the stakeholders that will benefit from implementing risk and reduction strategies. Implementation of effective interventions will lead to the production of safer food

products which will improve the overall public health.

What has been done
Critical to the development of risk-based approaches to food safety is the understanding of how pathogenic microorganism's presence/numbers relate to easy-to-measure physicochemical and microbial indicators. Currently employed standards throughout the food production and manufacturing sectors involve the frequent sampling for various indicator or index organisms. However, while dogma dictates that changes in indicators or indexes result in an increased risk for a product, very little published literature on this topic is available. One of the drawbacks of testing for pathogens or microbial indicators is the interval between testing and the time of result. In many instances, this time delay can range anywhere from 12 to 120 h depending on target organism(s) that are being detected. Obviously the long detection times preclude testing frombeing used in real time. To address these issues, we propose to evaluate and model these relationships using available and emerging technologies.

Results
? Enhanced safety of fruit, vegetable, dried fruit and nut, seafood, meat, and poultry products
? Increased understanding of food safety measures by regulatory personnel, producers, processors, consumers, extension agents
? Overall enhanced food safety and health for consumers
? Increased opportunities for trade of food products
? Increased capacity to meet growing food safety intellectual capacity for the country

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
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
607	Consumer 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

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The project will establish a Western Regional Food Safety Center at Oregon State University. The geographical area that the Western Center oversees consists of 13 states and 2 territories, and it encompasses more than half the land mass of the U.S. with over 50% of the specialty crop market value. Four Land-Grant Universities will serve as coordinating hubs for four subregions within the Western Center: - - Southwest sub-region - University of California, Davis
- Northwest sub-region - University of Idaho
- Mountain sub-region - Colorado State University
- Pacific sub-region - University of Hawaii, Manoa
Activities in the Western Region will be focused on developing trainers to deliver certified Produce Safety Alliance (PSA) and Food Safety Preventive Control Alliance (FSPCA) training workshops. The workshops will direct toward operators of small and medium-sized farms, beginning farmers, socially disadvantaged farmers, small food processors, and small fruit and vegetables merchant wholesalers affected by FSMA associated rules. Partnerships have been established with Land- Grant universities, stakeholder groups including state and local regulators, and community-based and non-governmental organizations. These partnerships will be leveraged to maximize training effectiveness and delivery opportunities. While the short-term goal is to establish an effective train-the-trainer program across the states in cooperation with the national center and other regional centers, the long-term goal is to improve food safety through training of a wide array of stakeholders across the western region of the U.S.

What has been done
A cadre of over 200 Lead Trainers for FSPCA Preventative Controls for Human Foods was developed. Through the established WR food safety networks in 13 western states and 2 territories, a total of nine FSPCA PC Human Food (PCHF) train-the-trainer (TTT) courses (7 in year 1 and 2 in year 2) and 11 PSA TTT courses were delivered.

Results
WRCEFS members also facilitated trainings or instructed PCQI courses in their regions. For example, 10 PCQI courses were delivered in the Northwest sub-region; 10 PCQI course were delivered in the Pacific sub-region; and in the Southwest subregion.
A cadre of over 328 Lead Trainers for the Produce Safety Alliance were achieved in the WRCEFS region.WRCEFS members trained growers through PSA integrated and grower trainings in their regions. Six grower trainings and 102 grower certificates were delivered in the Mountain sub-region, three in the Northwest sub-region (44 grower certificates), and three in the Pacific

sub-region (90 grower certificates). The Southwest sub-region supported attendance of 18 individuals from Universities, Extension, and NGOs to attend PSA lead trainer courses; five individuals received financial support to pursue the lead instructor certification.These lead instructors are anticipated to facilitate multiple PSA Grower courses during year 3 of the project.

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
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer Economics
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

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
While ?verified sustainable beef? has yet to be defined, there are three sustainable pillars shared by the US Beef Industry and Oregon Cattlemen?s Association including practices that are: economically viable, environmentally responsible, and socially diligent.

What has been done
Conducted research that assessed the nutritional value of local alternative feedstuffs & shared information within the extension program;
-Developed a course to using GIS technologies to map and monitor rangelands;
-Addressed socially diligent topics relevant to cattle producers?like the Veterinary Feed Directive.

Results
My Sustainable Rangeland-Based Beef Production extension program reached 364 clientele & met the requirements necessary for two landowners to receive nearly $100,000 of federal assistance. Specifically, I worked with the local NRCS office, Harney County OSU Livestock & Rangeland Field Faculty, Dustin Johnson, and one private landowners to organize and implement a field day to highlight rangeland health, monitoring, and improvements. The field day was necessary for the private landowners to receive a total of $40,000 of federal assistance. Finally, seven private landowners learned to map rangelands using Google Earth Pro. One landowner used the program to map soil samples and fulfill the federal requirements necessary to receive $80,000 for additional rangeland improvements.

4. Associated Knowledge Areas

KA Code	Knowledge Area
306	Environmental Stress in Animals
308	Improved Animal Products (Before Harvest)
311	Animal Diseases
502	New and Improved Food Products
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
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Recent foodborne outbreaks and recalls in the Pacific Northwest (PNW) involving strawberries (Escherichia coli O157:H7; Laidler et al., 2013), hazelnuts (Salmonella and E. coli; Harris et al., 2017, Oregon Health Authority, 2017) and basil pesto (FDA, 2017) have emphasized the need to prevent contamination, train farmers, farm managers, and farm workers about food safety in the fields. To address FSMA-knowledge and resource gaps in the areas of pre- and post-harvest food safety, water testing and sampling, and the development of farm food safety plans, we propose the development and delivery of food safety workshops and resources that will target the main agricultural production and processing systems in PNW. Previous training efforts in the region, such as trainings facilitated by the Western Regional Center to Enhance Food Safety (WRCEFS), have focused on the development of the cadre of trainers that can deliver the Food Safety Preventive Controls Alliance (FSPCA) and Produce Safety Alliance (PSA) curricula. However, there is presently a lack of coordinated trainings and assistance efforts in PNW for produce growers and processors. Building upon the food safety outreach program at the Oregon State University (OSU) Food Innovation Center and the North Willamette Research and Extension Center, and through close collaboration with WRCEFS, our project will lead, manage and coordinate regional produce safety trainings targeted at owners and operators of small and medium-sized farms, beginning farmers, socially disadvantaged farmers, small fruit and vegetable processors and merchant wholesalers affected by FSMA-related rules in Oregon.

What has been done
Objective 1. Adapt PSA curriculum to medium, small and very small growers and produce processors in PNW to include grower engagement, region-specific practices and commodities, and bilingual materials. The first stage of the proposed objective will focus on the engagement of four produce farms/facilities to collect information and receive industry input during the development of two food safety and two farm food safety plans that will be used as model plans during trainings. We will target commodities such as Oregon apples, berries, onions, and pears. The second stage of the objective will include collation of already existing regional training materials and WRCEFS add-ons for produce safety training, and review of the materials for their relevance to Oregon workshops. Throughout the process we will actively engage with PSA and WRCEFS, and when appropriate with Federal and State regulatory bodies in the western region, and other University
Extension programs participating in similar PSA training activities through Western, Southern, North Central, and North East Regional Centers.
Objective 2. Deliver adapted PSA curriculum to medium, small, and very small growers and

produce processors in PNW. Our plan is to deliver a total of four workshops (approximately 30-35 participants per workshop), two during each year of the project. Workshops will be held in the areas where most fruits and vegetable farms are located (i.e. Multnomah, Marion and Hood River Counties). Workshops will include in-person curriculum delivery with hands-on activities and time provided for participants to develop food safety plans or farm food safety plans.
Objective 3. Evaluate the impacts of education and training activities. Measurement of the impacts of objectives 1 and 2 will be performed on an annual basis using TOP method to target outcomes,
track progress, and evaluate performance (Rockwell and Bennet, 2004). Process evaluation will aim to measure what was done in relation to what was planned. To achieve this, we will monitor specific outputs that include the number of adapted PSA

Results
The expected outcomes of the project include:
1. Improved grower engagement during training through the development and delivery of adapted PSA curriculum that includes food safety plan development, WRCEFS add-ons relevant to western U.S. produce growing practices and commodities, and bilingual materials.
2. Increase in the number of Oregon fresh produce growers trained in produce safety using the PSA curriculum adapted to western U.S. practices and commodities.
3. Increase in the produce safety knowledge gain of trained Oregon growers, measured through pre- then post-test knowledge surveys.
4. Increased availability of bilingual food safety/farm food safety model plans for use in produce safety trainings.
5. Increased collaboration and standardized measurement of impact of outreach food safety trainings and initiatives in the Western U.S. through annual data sharing and biannual communication with WRCEFS, and online/in-person meetings with other food safety outreach grant-holders in the region, Oregon Department of Agriculture, USDA, FDA, and other FSMA Regional Centers.

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
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer 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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Nationally, produce growers are under increasing scrutiny related to on-farm practices that can cause or prevent food borne illness. These pressures come from the marketplace and also new federal rules issued under the Food Safety Modernization Act. The rules are complex and create new compliance challenges for many fresh market produce growers. After 4 years working with growers on outreach and education related to FSMA, rulemaking, and initial implementation, we knew Oregon growers had a strong preference to learn the rules and compliance strategies from other experienced growers, rather than from regulators or trainers with little or no farming and marketing background.

What has been done
We partnered with FamilyFarmed, a national organization offering a science-based on-farm food safety curriculum taught by experienced growers. We worked with FamilyFarmed, nationally known trainer Atina Diffley, and Oregon produce growers to tailor the curriculum to meet Oregon produce growers' needs and offered three full-day workshops in February, 2017: one for mid-scale growers and two for small-scale growers.

Results
76 farmers, representing 53 farms, attended the workshops. We conducted an on-site evaluation, using FamilyFarmed's required format, and FamilyFarmed conducted a follow-up evaluation in September/October (results reflected all 6 of their workshops in the Spokane RME region, 3 of which were ours).

On-site results:
?When asked if they had learned something useful to their farms, 100% answered "yes."
?When asked if the workshop would help them make more informed decisions about on-farm

food safety, 100% answered ?yes.?

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer 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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food Safety education continues to be a priority in each step of food production and Oregon?s berry commissions are highly committed to support their growers with updated information in Food Safety. The new Food Safety Modernization Act (FSMA) is a law since 2011 and enforces growers and processors to prevent food contamination following different rules of the law. The Produce Safety rule affects directly berry and produce growers, some could be exempt of the rule but others will need to be certified in the next couple of years. My last five years of experience

training and educating agricultural workers, farmers and farm managers in Food Safety, have helped me to identify the education needs, challenges and priorities to support the berry growers in Oregon.

What has been done
In 2017, I submitted a proposal for the SCBP at the Oregon Department of Agriculture. The main goal of this proposal was to obtain funds to develop resources for growers, farm owners, and managers to assist in continuous education in Food Safety practices especially dedicated to the sector of the berry industry. A second goal of this proposal was to provide new training opportunities to create awareness about the interpretation of the Produce Safety rule.

Results
Obtaining funds to accomplish a longed need for the berry industry is part of the impact; these funds will provide a long-term outcome after the educational materials are developed. The resources obtained from this grant will benefit to more than 900 trainers that have attended the Food Safety trainings in the last five years. Trainers are always in need of relevant educational materials especially during harvest season. In order to develop the most effective material, we plan to offer Produce Safety trainings around the Willamette Valley during the time of the project. During the first year trainings will be followed by a focus group to obtain feedback from the workforce, growers, and managers. The development of 4 videos, printed material and mobile friendly tool will be based on the results from the focus group, and the final products will be test and evaluated in the second year during additional educational events.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
607	Consumer 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
724	Healthy Lifestyle
903	Communication, Education, and Information Delivery

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The locavore movement continues to thrive and grow in Oregon. Initially only attracting fresh food enthusiasts about 8 years ago, now, a robust food preservation interest is taking root. While consumers know that they want to eat healthier, year-round and support local, sustainable systems to get the food that they want, they and some small producers-sellers frequently don?t have the food preparation, safety or preservation knowledge, skills or practice to ensure safe, healthy home food preparation or preservation methods. The Cooperative Extension Service has been providing food preservation information, training and resources for over 100 years here in Central Oregon, yet, our lifestyles have recently changed so dramatically that nearly two generations don?t know how to cook (Manore, M. 2010, FCH Conference). We have lost ?institutional memory? for safe food preparation and preservation methods and the knowledge that ?the Extension county home economist? has resources to help.

What has been done
In advertising and marketing classes in business colleges and programs make a point of sharing the breadth of research that has been done to get people to change their behavior. Generating ?word-of-mouth advertising? to family and friends is the most successful way to get consumers to take action and buy a new product or change to another product. The method used is nick-named, ?Get the message out 10 different times, 10 different ways.? I call it ?10 x 10.? Since messages can be designed for different target audiences, it is important to identify target audiences. We have identified three target audiences: the home cook is our main and largest target audience. But, because we need lots of reinforcement to reach this huge demographic and help extending the messages we also target clients who have participated our public workshops and our Master Food Preserver volunteers. We provide them with messages to make them feel valued and important in our shared mission to share information and resources that will help people make good choices when it comes to food safety and preservation.

Results
Target Audience: The Home Cook
Direct Education.
Public workshops: Deschutes, Warm Springs and Wheeler Extension offices.
One-on-one phone calls, emails and Ask an eXpert (food safety community of practice) questions.
Extension office walk-ins.
Pressure canner dial gauge testing with consultation about pressure canning methods.

Preserve @ Home on-line hybrid class with six-hour, hands-on lab at end of six-week series.
Off-site workshops:
?4-H Idea Fair
?Deschutes Public Library System, Know Food series.
Speakers: Garden Clubs in Bend, Prineville and Sisters

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
607	Consumer Economics
701	Nutrient Composition of Food
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

Not Reporting on this Outcome Measure

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
{No Data Entered}

What has been done
{No Data Entered}

Results
{No Data Entered}

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
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
603	Market Economics
607	Consumer Economics
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
903	Communication, Education, and Information Delivery

Outcome #12

1. Outcome Measures

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

Not Reporting on this Outcome Measure

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Interest in local and regional food among grocers, foodservice companies, restaurants and institutions is growing quickly, as is the number of farmers, ranchers and processors interested in selling to these markets. Public and private sector partners have made considerable investments in food hubs, food processing businesses and distribution networks that provide right-scaled ?hard? infrastructure. However, the effectiveness and impact of these infrastructure investments is hampered by a lack of active coordination between supply chain actors. Further, the relevant hard infrastructure may already exist but has limited capacity without clear connections to producers upstream and buyers downstream.

What has been done
In 2013, I co-authored a national report about this issue within the local meat sector: "From Convenience to Commitment: Securing the Long-Term Viability of Local Meat and Poultry Processing," funded by USDA's Economic Research Service. In 2015, USDA's Know Your Farmer/Know Your Food team used our report, in a proposal to the Rural Development Under Secretary?s office, as a key piece of evidence to justify new federal investment in value chain coordination, the ?Food LINC? program (initially called the Value Chain Development Initiative). Value chain coordinators connect producers to the right food distributors, processors, and consumers and facilitate the building of these relationships to ensure consistent and reliable flow of local products from farm to plate.

Results
The KYFKYF team received $500K in discretionary funds from Rural Development to start the Food LINC initiative to fund 7 value chain coordinators in 2016. This led over the course of 2016-2017 to a total investment of $2.7 million from Federal agencies, leveraged with $2.8 from philanthropy, to fund a total of 13 value chain coordinators across the country, and to develop a

Value Chain Coordination Community of Practice facilitated by the Wallace Center. The Food LINC program has had significant impacts in its first 2 years, highlighted in its own reports, including stronger chain relationships, increased producer capacity to supply these markets, and increased sales revenue across the chains.

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
603	Market Economics
607	Consumer 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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Prevention of food borne illness is an important public health effort. CDC estimates current cost of a single case of botulism in Oregon between $1.5 and $1.8 million dollars. Home preserved foods are often the culprit when there is an outbreak. Fortunately, Oregon averages less than 1 case per year. A number of other bacterial, parasitic and viral diseases are possible from poorly handled and preserved foods.

Food preservation and food safety remains a topic of great interest to Oregonians. OSU Extension Service remains the respected, reliable source for information. We continue to incorporate technology into our delivery methods.

What has been done

31 counties reported some level of Food Preservation and Safety educational programming.
48,872 individual contacts were reported.
Nineteen counties (11 separate programs) rely on trained Master Food Preserver volunteers to assist with outreach and engagement efforts. Support staff in county offices also play an important role in disseminating information. We are very grateful for their assistance.

69 new Master Food Preservers were trained, joining 256 veteran volunteers who receive additional training each year of their participation. These volunteers reported 19,183 hours of volunteer time.
240 community workshops and demonstrations were offered in Oregon in 2017 with an attendance of 4762.

Results

453 workshop participants completed surveys. Top changes in knowledge:
The importance of using current, tested recipes and instructions for food preservation and sources for them. 3.68
What equipment is necessary for preserving foods.3.55
99% of class participants planned to use the skills and knowledge learned in the class(es) they took.
97% indicated ?As a result of this class, I plan use up-to-date research-based home canning instructions.? 98% plan to check home-canned foods for spoilage before eating.

Eighty participants responded to a follow-up survey several months after the class they attended. Reflecting on their experience, participants indicated the following increases in knowledge (1-4 scale):
The importance of using current, tested recipes and instructions for food preservation and sources for them. (3.67)
To what extent did the class help you learn the food preservation skills that you needed? (3.62)

Master Food Preservers were surveys before training and after the food preservation season.

Reason or benefit for participating	Ranking before training	After training
To learn new skills	11	
To share my knowledge with others	22	

When asked to compare their knowledge before and after the training or update, MFPs indicated the largest increase in the following areas: Note that the biggest increases in knowledge were for methods and products of greatest health risk of safety or spoilage if not preserved properly.
1.Fermenting vegetables (2.15) (1-5 scale before and after, 5 being high)
2.Canning vegetables (2.14)

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
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 #15

1. Outcome Measures

Apply principals of integrated pest management and integrated crop management to improve food safety and environmental impacts of agricultural production.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This is an EIP project to address the primary area "IPM Implementation in Specialty Crops" (83% of budget), and the secondary area "IPM Training and Implementation in Schools" (17% of budget). Our specialty crop program involves needs assessments conducted with Extension agents and
stakeholders, and directly addresses eight economically important crops in Oregon and the Pacific Northwest: onions, cranberries, hazelnuts, cherries, grass seed, pears, mint, and potatoes, with impacts to many additional industries. We will compile economic data on pest losses and

production costs, and conduct IPM strategic planning. We will design extension outreach that will engage agents in addressing IPM priorities, pesticide risk management, and natural enemy/pollinator protection, with agro-ecological approaches. We will lead a watershed-based, multi-stakeholder pesticide stewardship partnership involving multiple specialty crop industries to reduce pesticide contamination in surface water. We will develop new pest models, technology, and system infrastructure for our climate and weather-based decision support tools. Our School IPM program will oversee trainings for school IPM coordinators and staff, it will prepare Head Start programs to meet IPM challenges that benefit at-risk students, and it will provide IPM training for environmental health inspectors to consider IPM in inspections.
We directly address CPPM program goals of improving IPM practices and economic sustainability with reduced environmental and health risks with a model for IPM implementation supported by state-of-the-science risk assessment and decision support tools developed by us in collaboration with local, regional, and national partners.

What has been done
The IPMSP process developed and employed by Murray in IPPC, adapts and integrates two key processes used for IPM engagement and consultation: Pest Management Strategic Planning (PMSP), and Crop Pest Losses Impact Assessments (CPLIAs). The IPMSP constitutes ongoing research and extension work initially funded through NIFA's Applied Research and Development Program (PD Murray, 2016). ALCE was developed to meet the challenge of providing education that responds efficiently and rapidly to IPM and pest management problems, with risk tradeoffs between production and human and environmental health. ALCE is a version of outcome-based education design. It is grounded in constructivism, a theory of learning which argues that individuals build new knowledge by adapting their past experience and knowledge to solve new problems. Using this method, IPPC will support agents in the extension IPM network in leading education workshops and events each year that will focus directly on the extension needs and priorities outlined in the IPMSP/PSP and FAB workgroup processes described below. Annual update consultations will take place for the extension educators based on project learning and outputs, via webinars and a website dedicated to instructor resources.

Results
New and underserved stakeholders gain knowledge about IPM and pesticide risk management (PRM) issues; growers increase knowledge of IPM/PRM in their systems and document priorities for research, education regulation; improved communication and collaboration between growers, IPM research, education, and extension communities, and regulators; growers learn how CPLIA can document pest losses, impacts and economic outcomes; increased availability and access to information on regional chemical use, aquatic residues, and local agroecology resources; extension professionals increase crop-specific knowledge of IPM practices and pest management needs; new outreach tools based on the PAMS approach increases understanding of IPM principles, consideration of pollinators/natural enemies, and risk management in target systems; production of audience-appropriate information and training materials; more responsive and user-friendly IPM DSTs are available.

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
501	New and Improved Food Processing Technologies
502	New and Improved Food Products

603	Market Economics
607	Consumer 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
724	Healthy Lifestyle
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

Food safety continues to be an area of concern for producers and consumers. OSU continues to devote considerable resources to exploring options for reducing potential toxins and pathogens in foods, improving pre harvest and post harvest food safety practices and developing new approaches for food handling, processing, and traceability. Like many research and outreach efforts, reduced federal and state funding greatly impacts our ability to deliver improved technologies associated with detection, prevention and tracking of food borne illnesses.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

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

Key Items of Evaluation

This AFRI Challenge Area promotes and enhances the scientific discipline of food safety, with an overall aim of protecting consumers from microbial and chemical contaminants that may occur during all stages of the food chain, from production to consumption. This requires an understanding of the interdependencies of human, animal, and ecosystem health as it pertains to food-borne pathogens. The long-term outcome for this program is to reduce food-borne illnesses and deaths by improving the safety of the food supply, which will result in reduced impacts on public health and on our economy.
In 2015-16, Food Preservation programming was reported in 30 counties. There are 15 active Master Food Preserve/Family Food Education programs at this time. Most of those encompass more than one county. 382 new and veteran MFP/FFE volunteers contributed over 25,524 hours of time in 21 counties, including: Central Oregon (Deschutes, Crook, Jefferson), Clackamas, Coos/Curry, Douglas, Hood River/Wasco, Jackson/Josephine, Klamath, Lane, Linn/Benton, Marion/Polk/Yamhill, Tillamook, Wallowa and Washington/Multnomah. They 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 41,000 contacts were made by volunteers, faculty and Extension staff in throughout Oregon, with 3,041 of these from callers throughout Oregon receiving assistance from the Food Safety/Preservation Hotline. The Hotline is operated with volunteer assistance during the food preservation and holiday season. In addition, over 260,000 Oregonians were reached by our faculty and volunteers through radio and television broadcasts, social media sites, and newspaper articles related to food safety and food preservation topics.

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	0%		5%	
703	Nutrition Education and Behavior	30%		20%	
704	Nutrition and Hunger in the Population	10%		20%	
724	Healthy Lifestyle	10%		20%	
802	Human Development and Family Well-Being	5%		15%	
806	Youth Development	20%		10%	
901	Program and Project Design, and Statistics	10%		0%	
903	Communication, Education, and Information Delivery	15%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	6.0	0.0	2.0	0.0
Actual Paid	3.0	0.0	1.1	0.0
Actual Volunteer	619.0	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**
64255	0	255789	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
64255	0	2521181	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
206823	0	1147281	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

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	9561	6447	5713	14455

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	32	19	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of children exposed to healthy eating and excercise

Year	Actual
2017	687

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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Jefferson County is ranked at 33% obesity and 18% physical inactivity. This is very concerning for the youth in our county. Changing the behavioral pattern by teaching the youth to be more active and eat healthy snacks will build the strong foundation of healthy living.

What has been done
Teens As Teachers and YA4-H (Youth Advocates 4 Health) worked with the local third grade classes in Metolius to bring the fun back into healthy exercise and eating. The teens used curriculum from the Balanced Energy Physical Activity Toolkit (BEPAT) to show the third graders that physical activities can be fun. The teens talked to the third grades and explained to them that exercise does not have to be a chore it can be fun if you make it fun. Once the games (exercises) were done the teens taught the youth how to make healthy snacks from recipes out of Food Hero and talked them about healthy portion sizes. Though a couple of the snacks did not sound to appetizing the teens ask the youth to try it.

Results
The third grade youth were excited to work with the Teens As Teachers. The Teens as Teachers were working on building that strong foundation of healthy living. Though some of the third graders were not excited about trying the "Popeye" smoothie which is made with spinach and the "beet smoothie" made with beets. However, we were very happy with the outcomes, after trying the smoothie 100% of the third graders said they would make those smoothies at home for their families. One youth said that he never liked beets until he tried the smoothie. Each of the third graders took home a recipe for all the healthy snacks and the games that they played. They all agreed that exercise can be fun when made into a game. With the youth all agreeing that exercise can be fun through games along with the willingness to try new foods and recreate those

snacks at home, shows the behavioral change we were wanting.

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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Studies cite obesity rates as one of the most serious health issues. Obesity risks are disproportionate among minority, low-income, rural populations, due to the inadequate distribution of resources and the community risk factors that contribute to the disparities. A needs assessment conveyed the need for opportunities for families in Malheur County to be physically active. Physical inactivity is more predominate in Malheur County, 30% compared to 17.7% in Oregon. Access to recreational facilities is comparatively low in Malheur County compared to Oregon and the United States.

What has been done
The principle focus of this program was to decrease physical inactivity and change health behaviors by creating opportunities for adult members of the community to be physically active. ?Increased opportunities and places for people to be physically active.

?2017, the program was delivered three times a week from January-April to 14 participants.
?Identified and promoted safe walking routes
?Engaged community partners from the beginning of the program and at various phases

Results
Short:
Participants improved their knowledge of the importance of physical activity.
Participants increased their understanding of the relationship physical activity plays on their health and understand the minimum PA requirements suggested as part of a healthy lifestyle.
Medium: Participants increased frequency of physical activity
34 participants participated 3 times a week for 16 weeks of BBB class.
At six month follow-up 90% of the participants report they are active 150 minutes a week.
Unintended outcomes: Safe walking routes were identified and promoted.
A healthy community activities group was formed. They meet once a week to participate in PA and healthy living activities.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
802	Human Development and Family Well-Being
901	Program and Project Design, and Statistics
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The proposed objectives are to 1) identify evidence-informed programs for healthy weight in childhood that focus on positive caregiver-child relationships, nutrition, and/or physical activity, 2) evaluate their quality and 3) integrate programs on positive caregiver-child relationships, nutrition, and physical activity to produce one or more synergistic programs for promoting healthy weight in childhood. These objectives align with my research prioritites (early childhood obesity prevention, child care settings, nutrition) and with identified national priorities. In recognition of the issues outlined in our objectives, the 2011 report, Early Childhood Obesity Prevention Policies from the Institute of Medicine of the National Academies, makes recommendations for increasing physical activity in young children, decreasing sedentary behavior, and increasing healthy eating. The central role of parents and other caregivers in the home and early care and education care centers (i.e., child care settings) is emphasized, and the need to educate parents and train child care program staff to carry out these recommendations is highlighted. Despite comprehensive recommendations and potential actions, practitioners' ability to implement strategies is limited in large part, we contend, due to a lack of programs that integrate recommended physical activity and nutrition practices for children (and the adults who must foster them) along with appropriate emphasis on parent/caregiver relationships that support adoption and maintenance of healthy behavior.

What has been done

Objective 1. Identify evidence-informed programs for healthy weight in childhood that focus on positive parent/caregiver-child relationships, nutrition, and/or physical activity
1. Review meta-analyses and systematic reviews (including those by W2005) of obesity prevention programs that include positive parent/caregiver-child relationships, nutrition, and/or physical activity to identify relevant programs.
2. Survey Cooperative Extension (including EFNEP) nationwide for obesity prevention programs presently being used that include positive parent/caregiver-child relationships, nutrition, and/or physical activity to identify relevant programs.
3. Develop list of programs.
Objective 2. Evaluate quality of existing programs.
1. Utilize GRADE to evaluate quality of evidence in programs found under objective 1.
2. Disseminate results of evaluation of quality of evidence for obesity prevention programs in each target area: positive parent/caregiver-child relationships; nutrition; physical activity.
3. Identify programs that integrate two or more of the above target areas.
4. Disseminate results of evaluation of quality of evidence of integrated programs.
Objective 3. Integrate programs on positive parent/caregiver-child relationships, nutrition, and physical activity to produce one or more synergistic program for promoting healthy weight in childhood.
1. Select program(s) that have the most potential for integrating all three target areas.
2. Contact authors of programs to determine willingness for adaptation.
3. Develop agreement (contract) as to authorship, credit, etc. of new program and collaboration on evaluating it (Objective 4).
4. Come to consensus the most efficacious ways to adapt the program(s).
5. Adapt program(s).
6. Conduct focus groups to collect pilot data on caregiver and child reactions

Results

1. Advanced science of practice in regard to child obesity prevention.
2. Increased understanding of the interacting roles of positive parent/caregiver-child relationships,

nutrition, and physical activity in prevention of child obesity.
3. Improved understanding of which child obesity program components should be incorporated into obesity prevention and intervention projects - based on W3005 evaluation of programs.
4. Increased number of effective synergistic programs integrating positive parent/caregiver-child relationships, nutrition, and physical activity

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
703	Nutrition Education and Behavior
802	Human Development and Family Well-Being
806	Youth Development
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Chiloquin is a small community with a depressed economy, high unemployment rate and limited access to healthy foods. In previous years, research team from GROW Healthy Communities obesity prevention grant collected data on weight status and physical activity of students and inventoried healthy food and physical activity resources in the region. The data supports what many that live in the area already know, youth in Chiloquin are generally in poor health; many are overweight (50% overweight or obese) and the region is a food desert. Summer is a particularly high risk time for youth in Chiloquin because they no longer have school meals and other

connections that school typically provides. The goal of this summer program was to provide healthy meals to youth and their families, provide social connections and physical activity with the ultimate goal to have the community adopt the summer lunch program long term.

What has been done
Extension faculty developed a new summer lunch program for the region that was tailored to the interests and needs of the community with support from student interns and community volunteers. Meals were prepared in a kitchen space donated by Klamath Tribes and local/regional guests were invited to lead activities and share resources over the 19 days of the program.

Results
Learning and good nutrition does not end when school lets out. With support from Chiloquin First Coalition, Tribes, School, local and regional organizations we served over 400 nutritious meals and provided healthy activities at the Chiloquin Summer Lunch Program. A system of meal production and delivery has been developed and can be used by Chiloquin community organizations and members in the future. At end of program sent survey to coalition member, of those that responded (n=6), 67% rated the program as good/very good and 83% agreed that the summer lunch program should continue to be offered in the future.

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Chiloquin is a small community with a depressed economy, high unemployment rate and limited access to healthy foods. In previous years, research team from GROW Healthy Communities obesity prevention grant collected data on weight status and physical activity of students and inventoried healthy food and physical activity resources in the region. The data supports what many that live in the area already know, youth in Chiloquin are generally in poor health; many are overweight (50% overweight or obese) and the region is a food desert. This project was funded by Phil Knight Cancer Institute to promote healthy eating, cooking and physical activity in the afterschool program.

What has been done
A series of 8 cooking sessions were designed and delivered to 30 third thru 6th grade students. They prepared simply recipes, learned cooking skills as well as food safety principles. Each session students received supplies to make recipes at home for their families.

Results
Evaluation will continue through 2018

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The consumption of fruit and vegetables has been linked to the mitigation of risk for chronic diseases such as obesity, diabetes, heart disease, and some cancers. In areas of high food insecurity, the only exposure some children have to fresh produce is when it is offered through school meal programs. Food security is important for children due to the nutritional influence on their psychomotor and neurocognitive development, mental health, school performance, test scores, behavior, and overall physical health. Food insecurity is of concern in Klamath Falls due to the fact that 25% of the residents live below the federal poverty line, 27% of the children experience food insecurity and over 70% of the students at Conger Elementary qualify for the free-and-reduced lunch program. Despite high rates of food insecurity, food waste is estimated to be very high, particularly for fruits and vegetables, in the cafeteria. Further assessment and recommendations were sought to address this concern.

What has been done
OSU KBREC faculty helped OIT Population Health students design assessment to evaluate food waste and provide recommendations to Conger ES. Students collected secondary data and primary data including observations, plate waste study, smarter lunchroom assessment and review of incentives and disincentives.

Results
Recommendations to increase consumption of healthy foods and reduce waste were made in a presentation to school staff and administration. These include: recess before lunch, involve students in cafeteria projects such as naming items and poster contents, present fruits and vegetables in an attractive way, use visual prompts, use salad bar and make white milk more accessible than chocolate. School administration plans to adopt several of the recommendations and will be working with SNAP-Ed to carry these out.

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the United States, approximately 1 out of every 3 children and teens is overweight or obese. In the prevention of childhood obesity, the CDC recognizes the influence of behaviors that influence excess weight gain include eating high-calorie, low-nutrient foods and beverages. The Healthy Columbia Willamette Collaborative?s 2016 Community Health Needs Assessment for Clackamas County found that only 21.6% of 8th graders consumed five or more fruits and vegetables per day.

What has been done
Our vision for OSU Extension Family and Community Health is ?lifelong health and well-being for every person, every family, every community?. Our goal as a program in Clackamas County is to meet our residents at many different life stages, and encourage fruit and vegetable consumption from an early age.

In 2017 we worked with five elementary schools across the county, and one middle school, to offer nutrition classes in school, after-school cooking classes, and school-wide food tastings in the cafeteria and at family nights.

Results
From self-reported data, the kindergarteners we taught showed a statistically significant increase in recognition of fruits and vegetables on the MyPlate icon over the course of the last school year after monthly visits. There were 18% more kindergarteners who could match a vegetable to its group and 13% more who could match a fruit. First and second graders, after a ten-week series of nutrition classes, showed a 41% improvement in identifying vegetables, and behavior changes started to appear in third through fifth graders. In that age range, 19% more children ate fruit more frequently and 22% ate vegetables more frequently.

These are small improvements, but they are moves in the right direction. Our impact in the schools is a result of our consistent involvement with them over the course of many years. Our presence has not only affected children?s self-reported behaviors, but has encouraged school administrators to improve cafeteria menus, increase opportunities for physical activity in the school environment, as well as encourage healthy snacks and celebrations. In 2017 we had 23 classrooms participate in a Healthy Harvest Celebration in lieu of a candy-filled Halloween party.

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 #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
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Behaviors including excessive sedentary activity and overeating of tasty high calorie foods contributes to obesity and poor nutrient intake among adolescent children. This age group is beginning to learn and develop their own independent eating behaviors. The frequency of these behaviors among early adolescents (10-13 years) is influenced by various personal, behavioral and environmental factors (Larson et al. 2013) with parents/caregivers playing an important role in food decisionmaking. Food choices are made by early adolescents during eating occasions with parental supervision and on occasions when parents/caregivers are not present (independent eating) to influence those choices. Early adolescents may have independent eating occasions at home, in school when away from home including eating with friends' homes, restaurants or convenience stores. It is necessary to further determine how parental practices (food choice rules/expectations, foods made available and role modeling) affect eating when adolescents are on their own.

What has been done

Objective I: Formative Evaluation: Interview early adolescent children and their parents. All states will participate in data collection for Objective I which will be led by the Oregon and Utah. Approximately 40-50 parents and their early adolescent children will be recruited to participate in the formative interview portion of the study. Parents and children will be interviewed separately by two interviewers at the same time and in the same location to allow the capture of conversation among both parents and children regarding the child's previous day's eating occasions. For each eating occasion in all contexts (home, school, with friends, etc), child participants will be asked about the context and information about each eating occasion over the 24 h. period, including who was present, the location, time of day and day of the week, other activities engaged in while eating, who prepared the food or where it was acquired, and the duration of the occasion.
Objective II: Quantitative Data Collection: Examine the association between key parental practices and positive eating behaviors during independent eating occasions among low-income, multi-ethnic early adolescence using quantitative methods.
Objective III. Quantitative Analysis: Examine the association between key parental practices and early adolescents' weight. The method to accomplish Objectives II and III will build on previous research conducted in W-1003 and W-2003 and from Objective 1 ot this study. The calcium motivator-barrier questionnaire (MBQ-P) for parents (Reicks et al. 2011) that was developed and validated in the previous W-1003 project will be used as a model. The MBQ-P consists of items that were combined into several scales to assess the frequency of parent practices associated with child calcium intake based on our previous qualitative research (Cluskey et al. 2008; Edlefsen et al. 2008). Calcium intake was assessed with a calcium-specific food frequency questionnaire (FFQ). In this project, a parent practice questionnaire will be developed based on findings from
Objective I. Validation of the questionnaire will occur as parents data will be assessed for the frequency of parent practices and their association with eating behaviors and food intake of early adolescents during independent eating occasions and with their weight.

Results

Food and beverage choices made by children at all eating occasions are of concern for healthy eating and for the prevention of obesity in youth. How parental practices translate into children's choices is an unknown area of investigation and more research is needed. These parental practices will result in an overall improvement in intakes of calcium rich foods/beverages, whole grain foods, fruits and vegetables and decreased consumption of high fat and sugar foods, and energy-dense foods/beverages among children. The nutrient density of non-meal eating

occasions will also be improved among children. Parent outcomes will include an increased frequency of supportive parental behaviors (such as setting expectations and making healthful foods available).
The short-term impact of this project includes the application strategies for multiethnic parents/caregivers to influence their early adolescent children to maintain healthy weights and establish and/or maintain healthy eating behaviors both during supervised and independent eating occasions. Medium-term impact includes increasing/continuing practices that encourage healthy food choices. Long-term impact includes prevention of unhealthy weight gain among early adolescents through maintenance of healthy eating behaviors, supported by positive parental practices. The significance of the project includes the direct cost savings in obesity-related health care costs associated with childhood obesity and the indirect costs associated with loss of school time, poor health and parental work loss with unhealthy children. There is social cost in our failure as a society to teach our children to value healthy eating and lifestyles. Our culture and social environment support and perpetuate behaviors. There is social value in teaching children to make healthy food and eating behaviors and determining how parents can best promote these behaviors will be impactful to society.

4. Associated Knowledge Areas

KA Code	Knowledge Area
610	Domestic Policy Analysis
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 #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)

Not Reporting on this Outcome Measure

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

Childhood obesity has reached epidemic levels in developed as well as in developing countries. Overweight and obesity in childhood are known to have significant impact on both physical and psychological health. Overweight and obese children are likely to stay obese into adulthood and more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age. The mechanism of obesity development is not fully understood and it is believed to be a disorder with multiple causes. Environmental factors, lifestyle preferences, and cultural environment play pivotal roles in the rising prevalence of obesity worldwide. In general, overweight and obesity are assumed to be the results of an increase in caloric and fat intake. On the other hand, there are supporting evidence that excessive sugar intake by soft drink, increased portion size, and steady decline in physical activity have been playing major roles in the rising rates of obesity all around the world. Childhood obesity can profoundly affect children's physical health, social, and emotional well-being, and self esteem. It is also associated with poor academic performance and a lower quality of life experienced by the child. Many co-morbid conditions like metabolic, cardiovascular, orthopedic, neurological, hepatic, pulmonary, and renal disorders are also seen in association with childhood obesity.

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 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.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Food Energy Water Nexus

☑ 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
111	Conservation and Efficient Use of Water	0%		20%	
112	Watershed Protection and Management	0%		10%	
132	Weather and Climate	0%		10%	
135	Aquatic and Terrestrial Wildlife	0%		5%	
402	Engineering Systems and Equipment	0%		10%	
403	Waste Disposal, Recycling, and Reuse	0%		10%	
405	Drainage and Irrigation Systems and Facilities	0%		20%	
501	New and Improved Food Processing Technologies	0%		15%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	5.0	0.0
Actual Paid	0.0	0.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
0	0	8056	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	79406	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	241680	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

CAS AES and Extension faculty will work with stakeholders including large production operations, small farm holders, and urban agriculturalists to improve water use efficiency and to reduce total use. This includes crating understanding among stakeholders of new varieties and cultivars that can reduce water usage while not reducing yields. Similarly, balancing the needs of food production, environmental stewardship, energy, and human health will be analyzed and presented.
Oregon hosts a number of food producers that use large volumes of water and this water is often utilized as supplemental irrigation in dry land regions. The impact of water reuse has not been sufficiently studied to determine the impacts of this water that is typically high in nutrients on shallow aquifers that are utilized both for agriculture and human use.
Aging water infrastructure requires inefficient use of energy and water that may or may not be compatible with new irrigation techniques and emerging cropping regimens. Best practices for replacing or rehabilitating this infrastructure must be evaluated and economic analyses conducted that can suggest methods for meeting the needs of 21st century agriculture.

2. Brief description of the target audience

Target audiences include agricultural producers, small farms, nurseries, small fruits producers, irrigation districts, state and federal agencies.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	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:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	11	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of producers adopting PV as part of their agricultural production system
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increase our knowledge and awareness of drought mitigation tools and strategies for farming with reduced or no irrigation water.
2	Investigate opportunities and risks associated with water reuse from a variety of sources including food processing, dairy and municipal sources, and industrial users such as oil and gas producers.
3	Develop greater understanding of the factors that contribute to resilience to economic and climatic perturbations at regional and farm level

Outcome #1

1. Outcome Measures

Increase our knowledge and awareness of drought mitigation tools and strategies for farming with reduced or no irrigation water.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
This project will investigate the role that soil organic matter structure plays on the ability of irrigation water to penetrate the soil surface, which affects soil water availability to plants. This potential new understanding will allow us to develop better soil management techniques for all soils, towards long term sustainability. The thrust for this project is the alarmingly rapid deterioration of agricultural soils in Oregon that happen to exist in what we call high-stress environments. These soils are "the canary in the mine" for all soils. Irrigated agriculture takes soils that were in equilibrium in their native climate, usually in a semiarid environment, into an irrigated condition that enhances organic matter degradation. Without a technique in place for properly managing the organic matter towards sustaining agro-ecosystem function, the result is a soil that degrades with time, and one of the first observable indicators is an increase in water repellency. Worldwide, the amount of irrigated land tripled between 1950 and 2000, satisfying the need for increased crop production. However, this trend has clear limits, leading to the ultimate constraint on human population growth being the availability of physical resources: water and arable soil. The situation is exacerbated by the potential impact of climate change where new drivers will be imposed on soils presently in use. Thus the long term sustainability of these soils is imperative and will require understanding of the mechanisms and properties that make these soils more resilient to stress (i.e. climatic and agricultural drivers) while maintaining a high degree of productivity. We use as our banner example and for testing, agricultural soils in the Columbia Basin of Oregon, a classic case of soils that respond rapidly to applied stresses.

What has been done
The premise behind this project is that sustaining a specific OM structure during agricultural activity will sustain soil wettability. The hypotheses underlying our approach is that surface hydrophobicity of mineral-organic particles can result either (i) from an unfavorable orientation of organic molecules attached to mineral surfaces as a consequence of moisture deficit or (ii) from

a depletion of the amphiphilic organic fragments that shield the inner hydrophobic organic molecular layer and result in a permanent loss of the hydrophilic interface with the soil solution. If confirmed, this concept may serve as a platform for the development of mechanism based strategies for the sustainable management of encumbered soils, i.e. soils that are particularly predisposed to be subject to perturbations of the molecular structure of organic matter attached to mineral surfaces. Project goals: 1. Test the hypothesis perform detailed laboratory analysis of OM structure and composition using field soil samples from "good" and "bad" cropping circles and develop a relationship between OM structure and wettability. 2. Quantify the resiliency of OM structure and soil wettability to climatic and agricultural management drivers. 3. With the assistance of growers, delineate management techniques that will sustain the desirable OM structure. 4.Initiate a long term field test to determine if these management techniques result in significant increase in productivity and decrease in soil stress.

Results

The first major insight obtained during this research was that soil wettability is positively correlated to moisture content. The Quincy soils show no infiltration problems when wet. A trivial, but not necessarily sustainable, solution to infiltration problems is thus to keep soils moist. In fact, the grower complaints that had motivated this research disappeared after a cool and (for the region) relatively moist spring, supporting the assessment that one important practice to avoid infiltration problems is to avoid letting the soil dry out. When soil subsamples were observed using a surface sensitive spectroscopic method (PAS-FTIR), the returned signal patterns changed as a function of moisture content, indicating a change in the water-OM relationship. This responsiveness of OM to water was stronger for soils that were classified by the grower as not having infiltration problems compared to soils from fields that were exhibiting reduced infiltration. These results indicate that a beneficial OM-water relationship that can improve infiltration potential is obtainable. Understanding the mechanisms by which moisture controls wettability will drive the next stage of investigation.

The second result was the realization that wettability is not constant across soil particle size fractions. Very fine particles (in the low micrometer range) tended to be more water repellent than larger particles (high micrometer size range). There was neither an obvious mineralogical reason, i.e. we were not able to attribute such behavior to the presence or absence of a given mineral, nor were we able to identify an organic matter characteristic that would correlate with such behavior.

The third major insight came from the observation of successful management practices. Some growers are able to manage the Quincy soil in a way that infiltration problems are almost completely avoided. Such practices involve additions of mobile forms of organic matter with a strong microbial signature (dairy effluent rich in polar carbohydrates and proteinaceous compounds). Wet tillage is used to incorporate these materials, allowing added organic matter and mineral grains to form porous aggregated crusts that allow for unrestricted infiltration of irrigation water. We thus conclude that impaired soil wettability is a complex phenomenon that needs to be understood at the pore/molecular scale, and that agricultural issues with wettability can be alleviated by targeted changes in agronomic practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
132	Weather and Climate
402	Engineering Systems and Equipment
405	Drainage and Irrigation Systems and Facilities

Outcome #2

1. Outcome Measures

Investigate opportunities and risks associated with water reuse from a variety of sources including food processing, dairy and municipal sources, and industrial users such as oil and gas producers.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Runoff from agricultural lands fertilized with livestock manures is a leading cause of water quality impairment in the United States. The watershed of Tillamook Bay, Oregon, an "Estuary of National Significance", suffers from widespread microbial contamination in spite of long-term monitoring, local conservation programs, and extensive Best Management Practice (BMP) implementation by dairy farmers. Current programs are not adequately controlling pollution from the farming sector; microbial source tracking studies found significant presence of dairy cow fecal contamination in the watershed. This integrated project will test a new approach using performance-based incentives to link real-time monitoring, farm-scale bacterial loss quantification, and microbial source tracking, to induce livestock producers to seek out and implement the most appropriate and cost-effective strategies for reducing bacteria loss from their farms. This project will also explore increasing producer motivation and cooperation through farmer-led watershed councils. Thus the project will focus on biophysical, social, economic, and behavioral practices needed to improve the adoption and maintenance of actions to improve water quality.

What has been done
The first goal of our project is to establish and test real-time, farm-scale monitoring of microbial contamination, use the monitoring results to measure the outcome of various management decisions and activities, and communicate the results with farmers. Focusing on the upper reaches of the Tillamook River, we will establish real-time bacterial monitoring, using it to direct detailed bacterial monitoring and microbial source tracking surrounding individual dairy farms. We will involve local producers and stakeholders by holding planning and training sessions in each aspect of the sampling and analyses. Outreach and education will engage youth through experiential learning. The second goal of our project is to demonstrate a cost-effective approach to reduce bacteria loads from dairy production through the use of flexible, performance-based incentives. The improved monitoring data generated by the first goal will provide feedback to

achieve this. The performance-based incentives will allow producers to seek out and implement the most appropriate and cost-effective actions to reduce bacteria loss on their specific farms. This project will address the major impediments to cost-effective control of NPS pollution from agriculture. The results of this project have the potential to greatly increase the efficiency and effectiveness of public and private conservation funding designed to mitigate bacterial contamination of surface water throughout the U.S. This project represents the first linking of real-time bacterial monitoring and cutting edge microbial source tracking with performance-based incentives, thereby increasingly the efficiency and effectiveness of public and private conservation funding to mitigate bacterial contamination of surface waters, and leading to science-based decision making and management practices that improve the quality of the Nation's surface water and groundwater resources in agricultural and rural watersheds.

Results

In order to establish and test real-time, farm and watershed scale monitoring of microbial contamination, we purchased a ZAPS LiquID water testing device. The manufacturer of this device claimed that it was able to continuously monitor and measure E. coli in water in real time. We set up the device in the Tillamook River. There were a lot of difficulties getting it to work at all. When we finally were able to get it to operate, it appeared to be monitoring tidal shifts rather than anything to do with bacterial contamination. We plan to test the ZAPS LiquID in controlled, laboratory settings in order to better understand our results in the field. Since being able to monitor bacterial contamination in real time is the basis of the project, we will need to understand whether the technology is working before we can continue.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
132	Weather and Climate
135	Aquatic and Terrestrial Wildlife
402	Engineering Systems and Equipment
403	Waste Disposal, Recycling, and Reuse
405	Drainage and Irrigation Systems and Facilities
501	New and Improved Food Processing Technologies

Outcome #3

1. Outcome Measures

Develop greater understanding of the factors that contribute to resilience to economic and climatic perturbations at regional and farm level

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Currently there are no integrated modeling frameworks to enable studies of resilience in agricultural system at regional scale. This proposal addresses this critical gap in knowledge and capabilities by proposing to develop an integrated modeling framework and will use this to evaluate the technical feasibility, economic viability and environmental impacts of agri-voltaic systems in Pacific Northwest. Additionally, we will also generate comprehensive datasets based on long term field studies for the first time for the agri-voltaic systems. The studies proposed in this proposal will be used to develop the frameworks for the Pacific Northwest regions and explore possibilities for more extensive regional and national scale frameworks through larger grants from state and federal agencies.

What has been done
Specific research objectives for this proposal are:
1.Conduct long term field experiments to monitor the agricultural production, water use, nutrient balance and energy performance of agri-voltaic systems.
2.Develop a comprehensive modeling framework for nutrient-energy-water nexus integrating biogeochemical, techno-economic and life cycle assessment models.
3.Calibrate and validate the developed framework using data from long term field experiments.
4.Evaluate scenarios for technically feasible, economically viable and environmentally less impactful implementation of agro-voltaic systems at regional scale.
Educational objectives of this proposal are to train graduate/undergraduate students in the integrated modeling, techno-economic analysis, LCA methodology, long term experiments, collecting samples and conducting laboratory analysis and performing statistical analysis. Emphasis will also be placed on training students in various modes of communication to peers and general public through posters, talks at conferences and publication of research in peer reviewed journals. Outreach objectives of this proposal are to liaison with the growers and other stake holders to inform them of the agri-voltaic systems technologies and its performance, nutrient energy water nexus and its relevance to their operational practices.

Results
Preliminary results for this project will be reported in 2018.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water

132	Weather and Climate
402	Engineering Systems and Equipment
405	Drainage and Irrigation Systems and Facilities

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

Equipment problems limited results for the contamination studies related to microbial contamination of estuaries from dairy operations. Conversely, studies on soil wettability defied expectation and has led this project in new directions.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Only a handful of pioneering studies have begun to address the potential symbiotic relationship between PV panels and agricultural systems. The formal introduction of agri-voltaic systems is credited to Dupraz in 2011 (Dupraz et al. 2011a). Not all agricultural crops are suitable, but plants with less root density and a high net photosynthetic rate are ideal candidates (Seidlova et al. 2009). An experimental study by Dupraz et el. (2011b) demonstrated that summer crops benefited more than winter crops such as pea and wheat crops. Agri-voltaic systems have been shown to increase land productivity by 60-70% (Dupraz et el. 2011b), and increase the value of energy production system by 30% (Dinesh et al. 2016). Marrou et al. (2013a) observed an increase in fresh weight of cucumbers and lettuce in an agri-voltaic system relative to a control and attributed the change to decreased soil water tension. Another experiment by Marrou et el. (2013b) found that canopy development is more rapid under the shade of solar panels relative to a control. Agri-voltaic systems have also been shown to increase water use efficiency.

Key Items of Evaluation

We conclude that full elucidation of the mechanisms and an eventual prediction of variations in soil water repellency will require a fundamental revision of traditional research approaches. Attempts to understand water repellency solely as a molecular scale, surface problem (such as our original project design) will be insufficient, as they neglect the potentially overriding effects of particle arrangement at the much larger micron scale, and the time relationship associate with the wettability of polymeric substances. We speculate that in soils with higher clay content, and consequently, stronger formation of mm size aggregates, there might actually be another, even larger scale to consider.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
687	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
7	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)	
5	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
2	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.